Analysis of the U.S. Environmental Protection Agency's Records of Decision Related to Landfills

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Prepared for the

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Introduction

The Idaho National Engineering and Environmental Laboratory (INEEL) faces a suite of environmental challenges. Many of these challenges bring with them the prospect of decades' worth of activity ranging from site analysis to remediation to long-term stewardship and monitoring. Waste Area Group (WAG) 7 is one such challenge. Covering approximately 174 acres of high, arid to semi-arid steppe ecosystem in southeast Idaho, WAG 7 (the designation for the Radioactive Waste Management Complex) was designed to permanently and retrievably store radioactive, transuranic (TRU), and mixed wastes. WAG 7 encompasses the 95.9 acre (38.8 ha) Subsurface Disposal Area (SDA), the 56 acre (23 ha) Transuranic Storage Area (TSA), and a 22 acre (9 ha) Administrative Area.

The Subsurface Disposal Area encompasses trenches, soil vaults, an asphalt pad, and an acid pit that are used for the disposal of high-activity wastes. During its operation, TRU and non-TRU wastes were stored, often side-by-side, in these units. These wastes have been sourced from INEEL, the former Rocky Flats Plant, and from commercial AEC licensees. The waste containers (cardboard boxes, wooden crates, and drums, along with non-packaged bulky wastes) have been alternately neatly stacked and randomly dumped from trucks. Following emplacement of the wastes, they were covered with soil on varying schedules (all wastes were covered at least on a weekly basis). Later disposal activities at the SDA were designed to ensure the retrievability of all solid waste contaminated with long-lived TRU in concentrations of greater than 10 nCi/g (nanocuries per gram). The asphalt pad contained within the SDA currently holds waste that contains transuranic materials, but does not meet the requirements for TRU waste. This containerized waste is currently covered by soil.

Ensuring retrieval of TRU waste led to the creation of the Transuranic Storage Area. This above-grade area covers 56 acre (23 ha), consisting of several large asphalt storage pads, the Intermediate Level Transuranic Storage Pad, the Stored Waste Examination Pilot Plant, and other facilities. Waste stored at the TSA is containerized, stacked in subdivided cells, and covered with dirt.

The SDA and TSA are active disposal and storage areas. Wastes today are segmented by type, compacted where possible, and placed in pits or in cells on the asphalt pads. Both contact-handled and remote-handled low-level wastes are stored, as are TRU wastes and high level wastes.

The entire WAG-7 area is located above the Snake River Plain aquifer, a designated sole-source aquifer under the Safe Drinking Water Act. Within the vicinity of WAG 7, the water table is located at depths of approximately 900 ft (274 m). The site is dry (with an average annual precipitation of 8.7 inches [22.1 cm]), is highly isolated from population centers (INEEL as a whole possesses a 320 acres (130 ha) buffer zone that is currently used for grazing, as well as a Bureau of Land Management (BLM) managed buffer zone), and possesses an extraordinarily thick vadose zone between the surface and the water table.

As a component of INEEL's preparations for entering into a Record of Decision (ROD) on remedies at WAG 7, this report details RODs developed at sites with similar wastes and storage

structures. The intent of this review is to provide insight into what remedies have been accepted for similar challenges, and to evaluate the level of comparability between WAG 7 issues and the issues addressed by RODs summarized in this report. This work is not intended as a comprehensive evaluation of the suitability of applying remedies from other sites to WAG 7. Rather, it is a preliminary scoping and identification exercise that can be used by INEEL in the furtherance of WAG 7-related work.

The methodology behind this scoping and identification exercise can be found in the following section. The exercise focused its attention specifically on landfills and other units where radioactive wastes, transuranic wastes, and mixed wastes were, or still are, placed.

This report is divided into three parts: the methodology section; summaries of the RODs that deal with wastes and waste emplacements most similar to those found at WAG 7; and a short analysis section that begins the process of comparing and contrasting the attributes of the selected RODs against the prevailing conditions at WAG 7. Following the body of the report is a series of appendices that contains: a summary table of all the RODs reviewed; an explanation as to why each was eliminated from the process; and tables outlining the volumes of contaminants of concern from the selected RODs.

Methodology

Record of Decision (ROD) Identification and Collection Approach

As a primary step in the ROD identification approach, an exhaustive review of on-line EPA resources was conducted. Reviewing resources electronically rather than in hard copy form was selected because it allowed for sifting through a considerable volume of information in a short amount of time.

Extensive use was made of EPA's Superfund Hazardous Waste Site Advanced Query Form. This user-defined search tool allowed the selective definition of criteria of interest – in particular, searches were conducted that selectively identified "radioactive" constituents as contaminants of concern. In addition, the database was queried to identify RODs where "radioactive" was listed as a key word or where the term appeared in the text of the ROD abstract. This search tool was used to generate the primary list of RODs of interest. However, the Advanced Query Form web page indicates a "last updated" date of December 1, 1999.

To ensure access to the most up-to-date information available, a copy of the current issue of the RODcite CD-ROM was obtained. RODcite, distributed by the National Technical Information Service, is a complete, up-to-date database that includes the text of all RODs, multi-page summaries of the RODs, and a powerful search engine. The interface is designed to allow searches of the database using fields like cost, contaminant, and location in combination with phrases in the ROD text. RODcite contains the complete text of the official ROD documents signed and issued by the EPA Superfund program since 1982.

Recognizing that on-line and CD-ROM databases will not necessarily contain the most up-to-date information available (due to production time lags), attempts were made to contact individuals within EPA regional offices. The purpose of this activity was to discern the presence of newly signed RODs or RODs that were essentially complete and awaiting signature.

To ensure that the data collection process described above did indeed provide a listing of RODs as comprehensive as one could be reasonably expected to achieve, non-governmental organizations were contacted to 'sanity-check' the preliminary findings. One organization included the Tri-Valley CARES, an environmental citizens "watch-dog" group that works on radioactive issues associated with the government. Also, officials from the EPA Waste Management Emergency and Long Term Hazardous Waste Site Cleanup Division for Regions 2-5 & 8-10 were contacted in reference to the deselecting process.

ROD Screening Approach

The screening process applied to the collected RODs was designed to eliminate RODs that address issues with little resemblance to those facing INEEL at WAG 7. The three-step screening process, discussed below, allowed for a quick and accurate screening to reduce the large number of RODs down to the dozen or so RODs that are relevant to the scope of this study.

In **Step 1**, both the EPA's Superfund Hazardous Waste Site Advanced Query Form and the RODcite CD-ROM were searched for RODs that contained the term "radioactive" in either a

keyword field or in the ROD abstract. As originally planned, Step 1 was to have selected RODs based on the term "landfill" or "buried waste." However, an initial run through the databases using this method returned an unacceptably large number of responses – thus, the study team quickly ascertained that the first screen should use the term "radioactive." Using this term rather than "landfill" or "buried waste" quickly narrowed the area of study to less than 100 RODs. However, the range and scope of these RODs was considerable – RODs dealing with small volumes of radioactive medical waste were interspersed with RODs from the Department of Energy's Hanford Site.

In **Step 2**, the discrete list of RODs generated in Step 1 was winnowed to those most relevant to the needs expressed by INEEL. In particular, the following guidance provided by INEEL was adhered to:

- Identify RODs that contain remedies for landfilled or buried radioactive/ transuranic waste.
- Eliminate RODs that are limited to treatment of vadose zone or aquifer plumes emanating from a landfilled or buried source.

Using these guidelines, the ROD abstracts obtained in Step 1 were read (at this point in the process, automated searching becomes less useful – discerning the applicability of one ROD versus another is best conducted by people). While reading the abstracts, the guidance provided by INEEL was combined with background knowledge of the challenges facing INEEL's WAG 7 – this resulted in the discarding of numerous RODs (see box at right for a sample of these discarded RODs). A table listing these RODs, their contaminants, remedies, site types, and reasons for elimination are provided in Appendix B.

Discarded RODs – A Sampler

Essex County (NJ) Radium Sites – Large volumes of radioactive tailings deposited on site. After operations ceased, tailings were removed to an off-site location and the property sold. Elevated levels of radon gas and gamma radiation are now found in the neighborhood built on the former site. Discarded because waste was not landfilled/buried.

Mound Plant (OH) – A former nuclear weapons complex facility, the Mound Plant has signed one ROD to date. This ROD addresses the remediation and containment of groundwater-entrained contaminants from a closed landfill. Contaminants of concern included Pu-238 and Sr-90. Discarded because ROD does not address landfilled contaminants.

Lowry Landfill (CO) – Sanitary landfill used for the disposal of a variety of wastes, including low-level radioactive wastes. Discarded because the wastes are not relevant to INEEL.

Following completion of Step 2, only 10 RODs remained. Summaries of these RODs have been constructed from EPA documents, and are supplied in the following section. Following the narrative of these summaries, an analysis comparing and contrasting these RODs with the challenges faced at WAG 7 was developed.

Summaries of Selected Records of Decision

Idaho National Engineering and Environmental Laboratory, Overview

The Idaho National Engineering and Environmental Laboratory (INEEL) is a U.S. Department of Energy multiprogram national laboratory located in southeastern Idaho on the northeast portion of the eastern Snake River Plain. The INEEL site, located on an 890 square mile government reservation, is located 32 miles west of Idaho Falls (population 46,000).

In December 1991, the EPA, DOE, and Idaho Department of Health and Welfare (IDHW) signed the Federal Facility Agreement and Consent Order (FFA/CO) that superseded the Consent Order and Compliance Agreement (COCA). This agreement provides the process and schedule to facilitate cleanup of the areas identified in the FFA/CO Action Plan, in accordance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), and the Hazardous Waste Management Act (HWMA).

Description/History of Site

Established in 1949 as the National Reactor Testing Station, the missions undertaken at the INEEL have grown to meet the changing needs of the nation and the Department of Energy. At present, the primary focus of the laboratory is meeting the environmental remediation challenges at its own and other sites as the DOE attempts to cleanup the legacy of nuclear weapons production and research.

Summary of Local Physical Conditions

The INEEL property is located on the northeastern edge of the Eastern Snake River Plain, a volcanic plateau, which is primarily composed of silicic and basaltic rocks and relatively minor amounts of sediment. Underlying the Radioactive Waste Management Complex (RWMC) is a series of basaltic lava flows with sedimentary interbeds. The basalts immediately beneath the site are relatively flat and covered by 20 to 30 ft (6 to 9 m) of alluvium.

The depth to the Snake River Plain aquifer underlying the INEEL varies from 200 ft (61m) in the northern portion to 900 ft (274.3 m) in the southern portion of the INEEL. The depth to the aquifer at the RWMC is 580 ft (177 m). Regional groundwater flow is generally to the southwest.

The climate of the region is arid to semiarid with hot summers and cold winters. Normal annual precipitation is 9 in/yr (23 cm/yr), with estimated evapotranspiration of 6 to 9 in/yr (15 to 23 cm/yr). Twenty distinct vegetative cover types have been identified at the INEEL, with sagebrush being the most dominant species, it covers approximately 80 percent of ground surface.

Most of the area surrounding the INEEL is either unimproved rangeland or farmland, which provides a **buffer zone** of roughly 320 acres (129.5 ha). However, grazing is prohibited within 2 miles (3.2 km) of any nuclear facility and no dairy cows are allowed. Approximately 95 percent

of the INEEL site has been withdrawn from the public domain by land transfer from the U.S. Bureau of Land Management to the Department of Energy.

INEEL, Pit 9

Site Name:	INEEL
ROD:	EPA/ROD/R10-93/070
Site Ownership:	Federal
Site Focus Location:	Pit 9 at the RWMC, Subsurface Disposal Area
Contaminant of Concern:	**TRU radionuclides**-plutonium Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, and americium Am-241,VOCs, other organics, and metals
Remedy:	The preferred **remedial action** includes Proof-of-Process, limited production test, excavation, treatment and segregation of waste, return of treated materials to Pit 9, volume reduction by approximately 90 percent, and on-site storage. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 10 - Idaho
Site Size:	144 acres (58.3 ha)
Waste Media:	Drums, cardboard boxes and packages of assorted solid waste, and sludge. 4,072 yd^3 (3,114.8 m^3) ***See summary of deposited wastes for further details.***

Description/History of Site

The RWMC was established in the early 1950s as a disposal site for solid, low-level waste (LLW) generated by INEEL operations. Within the RWMC is the SDA where radioactive waste materials have been buried in underground pits, trenches, soil vault rows, and one above ground pad (Pad A), and the TSA where containerized TRU waste is stored in an intern-basis on asphalt pads. TRU waste was disposed of in the SDA from 1952 to 1970 and was received from the Rocky Flats Plant for disposal in the SDA from 1954 to 1970. The Rocky Flats Plant is a DOE-owned facility located west of Denver, Colorado, and was used primarily for the production of plutonium components for nuclear weapons. The TSA accepted TRU waste from offsite generators for storage from 1970 to 1988. TRU waste generated at the INEEL is still received and stored in the TSA.

Since 1970, solid TRU waste received at the RWMC has been segregated from non-TRU solid waste and placed into interim retrievable storage at the TSA. RWMC LLW that is contaminated with TRU isotopes less than or equal to 100 nanocuries per gram (100 nCi/g) but greater than 10 nanocuries per gram (> 10 nCi/g) is excluded from disposal at the RWMC and is placed in interim storage at the RWMC.

Summary of Deposited Wastes

Waste was placed in Pit 9 at the SDA from November 1967 to June 1969. It presently has an overburden that averages about 6 ft (1.8 m) thick. Approximately 925,925 yd^3 (707,962 m^3) of overburden, 555,555 yd^3 (424,777 m^3) of packaged waste, and 1,296,295 yd^3 (991,147 m^3) of soil were between and below the buried waste at the time of Pit 9 closure. The depth of the pit from ground surface to the bedrock is approximately 17.5 ft (5.3 m), and the horizontal dimensions are approximately 379 x 127 ft (116 x 39 m).

While Pit 9 was operational, drums and boxes were generally dumped in the pit by truck or bulldozer. Large items were placed in by crane. Soil cover was applied over the waste on a weekly or daily basis, depending on the required procedures at the time of disposal. After the waste was placed in the pit, the pit was backfilled with another layer of soil.

The inventory of contaminants in Pit 9 is based on available shipping records, process knowledge, written correspondence, and the Radioactive Waste Management Information System (RWMIS). The waste in Pit 9 is primarily transuranic waste (as defined in 1969) as >10 nCi/g) generated at the Rocky Flats Plant with additional low-level and other miscellaneous wastes from generators located at the INEEL. Approximately 407,407 yd^3 (2,381m^3) of the waste buried in Pit 9 was generated at the Rocky Flats Plant and consisted of drums of sludge (contaminated with a mixture of TRU elements and organic solvents), drums of assorted solid waste, and cardboard boxes containing empty contaminated drums. Buried at the site were 3,937 drum containers, 2,452 boxes (of which 1,471 contain empty contaminated drums), and 72 unspecified containers of waste. The boxes were generally disposed of at the north end of the pit, and the drums were generally dumped in the south end, although intermixing of containers in the pit did occur as a result of pit flooding in 1969.

Six TRU radionuclides (plutonium Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, and americium Am-241) compose 99 percent of the radioactivity originally placed in Pit 9. Pit 9 also contains the following uranium U and thorium Th isotopes: U-234, U-235, U-238, and Th-234. Other categories of radionuclides in Pit 9 are mixed activation products and mixed fission products; cobalt Co-60, barium Ba-137, cesium Cs-137, strontium Sr-90, and yttrium Y-90.

Some drums of 741 sludge contained low concentrations of beryllium, on the order of 1,000 mg/kg [1,000 parts per million (ppm)]. Based on shipping records and process knowledge, an average concentration of beryllium across all drums of 741 sludge was estimated to be 500 ppm (500 mg/kg). The drums of 742 sludge packaged at the Rocky Flats Plant before Pit 9 closure may contain other waste items, such as electric motors, containers of liquid chemical waste, and other materials. Chemical wastes (generally liquids) contained in polyethylene or glass bottles were periodically included in the 742 series drums. Before Pit 9 closure, small amounts of contaminated mercury in half-liter bottles were periodically placed in drums. In addition, mercury and lithium batteries were periodically included in these waste drums.

Series 743 sludge consisted of a mixture of 30 gal (114 l) of organic liquid and 100 lb (45 kg) of calcium silicate along with 10 to 20 lb (5 to 9 kg) of oil absorbent. The organic liquid was described as consisting of about 47 percent lathe coolant (60 percent Texaco Regal oil, 40 percent carbon tetrachloride), 10 percent degreasing agents (trichloroethane), and 43 percent

miscellaneous organic compounds consisting of unspecified amounts of carbon tetrachloride; chloroethylenes; hydraulic, gear box, and spindle oils; Freon; Varsol; and trace amounts of laboratory wastes (organophosphates, nitrobenzene). In addition, an unknown amount of oil contaminated with polychlorinated biphenyls (PCBs) was processed with the other organic wastes in 743 sludge. Low concentrations of beryllium are present in some of the series 743 sludge.

In each drum containing series 744 sludge, approximately 26 gal (98 l) of waste were mixed with 190 lb (86 kg) of Portland cement and 50 lb (23 kg) of magnesia cement. Approximately 10 to 15 lb (4.5 to 7 kg) of additional Portland cement was placed on top of the cement mixture before sealing in a plastic bag. The contents of series 745 sludge are described to be 60 percent sodium nitrate, 30 percent potassium nitrate, and 10 percent miscellaneous. The miscellaneous mass consisted of organic wastes and used items. Examples of the miscellaneous contents are odds and ends like rags, paper, and gloves, and organic compounds like alcohols, organic acids, and ethylenediaminetetraacetic acid.

Discussion of Issues Leading to the ROD

A series of opportunities for public participation in the decision process for an interim action at Pit 9 were provided beginning in November of 1991 for the original proposed plan and in October of 1992 for the revised proposed plan. These activities were conducted in accordance with public participation requirements of CERCLA 113(k)(2)(B)(i)-(v) and 117. For the public, the activities ranged from receiving a fact sheet and an original and revised proposed plan, to having telephone briefings, public informational meetings, and public meetings to offer oral or written comments during two separate 60-day public comment periods.

Similar display advertisements appeared in local newspapers several days preceding each local meeting to encourage citizens to attend and provide verbal or written comments. Three local media (the Dear Citizen letter, news release, and newspaper advertisements) gave public notice of four informational meetings concerning the cleanup of Pit 9 and the beginning of a 30-day public comment period, which was to begin December 4, 1991. Additionally, two radio stations in Idaho Falls and newspapers in Idaho Falls and other communities repeated announcements from the news release to the public at large. Phone calls concerning the availability of the plan and public meetings were made to individuals, environmental groups, and organizations by INEEL outreach office staff in Pocatello, Twin Falls, and Boise.

An open house was held in Idaho Falls on January 7, 1992, for one hour before the public meeting to allow citizens an opportunity for informal discussion with IDHW, EPA, and DOE representatives concerning Pit 9. During the meeting that followed, representatives from the DOE, EPA, and IDHW discussed the project, answered both verbal and written questions, and received public comments. A court reporter prepared a verbatim transcript of the public meeting. Written comment forms were distributed at the meeting. Both the meeting transcript and written comments were placed in the Administrative Record section of the INEEL Information Repositories under the heading of Pit 9, Operable Unit 7-10.

After reviewing public comments and learning details about the processes that could be used in association with the preferred remedial alternative, the agencies concluded that a revised plan was warranted. On October 16, 1992, the revised proposed plan for Pit 9 was mailed to 5,600 individuals on the mailing list for review and comment.

A responsiveness summary has been prepared for both the original and revised proposed plans as part of the ROD. All formal verbal comments, as given at the public meetings, and all written comments, as submitted, are repeated verbatim in the Administrative Record for the ROD. Those comments are annotated to indicate which response in the responsiveness summary addresses each comment.

Summary of Actions Proposed

Capital Cost:	$20.6 million
Present Worth:	
Months of Operation:	
O&M:	$29.1 million

This ROD addresses the contamination of Pit 9 at the RWMC, Subsurface Disposal Area at the Idaho National Engineering & Environmental Laboratory. The RWMC has been designated as Waste Area Group (WAG) 7 of the 10 WAGs at the INEEL that are under investigation pursuant to the Federal Facility Agreement and Consent Order between the Idaho Department of Health and Welfare, the EPA, and the U.S. Department of Energy Idaho Operations Office. Pit 9, designated Operable Unit 7-10, is located within WAG 7. The selected remedy for Pit 9 will use a combination of chemical extraction, physical separation, and stabilization technologies to recover contaminants and reduce the source of contamination.

The major components of the remedy are:

- Proof-of-Process (POP) to demonstrate that designated performance objectives and cleanup criteria are attainable;
- Limited Production Test (LPT) to give a high degree of confidence that performance objectives and cleanup criteria can be met at all systems;
- Excavation and segregation of waste with greater than 10 nanocuries per gram (> 10 nCi/g) of TRU elements for input into the treatment process;
- Treatment of waste using chemical extraction, physical separation, or stabilization to remove radionuclides and hazardous constituents and to reduce the toxicity, mobility, and volume of those wastes that remain;
- Treatment of listed hazardous waste to levels which will allow for delisting of the waste (for material being returned to the pit) in accordance with the Resource Conservation and Recovery Act and the Idaho Hazardous Waste Management Act;
- Return of treated materials to Pit 9 (treated materials will contain less than or equal to 10 nCi/g, of TRU elements and meet regulatory standards for hazardous substances of concern);
- Volume reduction by approximately 90 percent for material undergoing treatment; and

- Onsite storage of concentrated waste residuals in accordance with Applicable or Relevant and Appropriate Requirements (ARARs) until final disposal.

Because some aspects of the remedial technologies have not been proven to reduce contamination of hazardous waste sites like Pit 9, the preferred remedial alternative is contingent upon demonstration that the cleanup criteria and other performance objectives can be met in the POP and LPT test phases. If the processes are not successful in the POP or LPT test phases, then Pit 9 will be re-evaluated for remediation at a later date but no later than the TRU-Contaminated Pits and Trenches OU 7-13 Remedial Investigation/Feasibility Study of the FFA/CO. Additionally, if the POP results demonstrate the process is not cost effective, then Pit 9 will be re-evaluated by DOE, IDHW, and EPA for remediation.

INEEL, SL-1 and BORAX-1 Burial Grounds

Site Name:	INEEL
ROD:	EPA/ROD/R10-96/132 and 96/147
Site Ownership:	Federal
Site Focus Location:	The Stationary Low-Power Reactor-1 (SL-1) and Boiling Water Reactor Experiment-I (BORAX-I) burial grounds
Contaminant of Concern:	Radionuclides, Europium-154, Cesium-137, Strontium-90, Uranium-234, -235, Cobalt-60, and Thorium-228, -230, -232
Remedy:	The selected final actions include: containment by capping with an engineered barrier constructed primarily of native materials; for BORAX-I, implementation will include consolidation of surrounding contaminated surface soils for containment under the engineered cover; contouring and grading of surrounding terrain to direct surface water runoff away from the caps; periodic above-ground radiological surveys following completion of the caps to assess the effectiveness of the remedial action; periodic inspection and maintenance following completion of the caps to ensure cap integrity and surface drainage away from the barriers; access restrictions consisting of fences, posted signs, and permanent markers; and restrictions limiting land use to industrial applications for at least 100 years following completion of the caps. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 10 – Idaho
Site Size:	SL-1 4,000 acres (1,618 ha), BORAX-I 2,000 acres (809 ha)
Waste Media:	3.6 million yd^3 (2,803,530 m^3) of radionuclide contaminated debris, soil, and gravel located in a buried tank

Description/History of Site

The SL-1 and BORAX-I burial grounds were constructed to dispose of contaminated debris, soils, and gravel generated by the destruction of a small nuclear reactor at each location. The BORAX-I burial ground was established in 1954; the SL-1 burial ground was established in 1961. Both sites were identified in the Consent Order and Compliance Agreement, which was signed by the EPA and the DOE and promulgated in 1987 pursuant to the Resource Conservation and Recovery Act Section 3008(h). Under this agreement, the DOE initially assessed and screened the sites and established a procedure for conducting corrective actions.

The SL-1 Burial Ground

The SL-1 was a small nuclear power plant designed for the military to generate electric power and heat for remote arctic installations. The reactor was operated from August 1958 until January 1961, as a testing, demonstration, and training facility. On the evening of January 1961, the SL-1 reactor accidentally achieved a prompt critical nuclear reaction, which caused a steam explosion that destroyed the reactor and resulted in the deaths of the three operators on duty. The reactor vessel and building were severely damaged and highly contaminated and a massive cleanup operation ensued to dismantle and dispose of the reactor and building.

The SL-1 Burial Ground consists of three excavations in which a total volume of 3.56 million yd^3 (2.7 million m^3) of radionuclide-contaminated debris, soil, and gravel are disposed of in the burial ground. The excavations were dug as close to basalt as the equipment used would allow and ranged from 8 to 14 ft (2 to 4 m) in depth. At least 2 ft (0.6 m) of clean backfill was placed over each excavation. Shallow mounds of soil over the excavations were added at the completion of cleanup activities in September 1962. Operable Unit 5-05 is defined as the surface and subsurface soils and debris within the 600 x 300 ft (183 x 91 m) SL-1 burial ground exclusion fence and the surface area surrounding the burial ground.

During a survey of surface soil in June 1994, "hot spots" were found within the burial ground with activities ranging from 0.1 to 50 milliroentgen (mR)/hour. On November 17, 1994, the highest radiation reading measured at 2.5 ft (0.75 m) above the surface at the SL-1 burial ground was 0.5 mR/hour; local background radiation was 0.2 mR/hour. A dose equivalent rate survey was conducted in 1995; all locations surveyed within Operable Unit 5-05 yielded readings at or below the background value of 20 μrem/hr.

The BORAX-I Burial Ground

The BORAX-I Burial Ground is located about 2,730 ft (832 m) northwest of the Experimental Breeder Reactor-1, a national monument. The BORAX-I site includes a 200 x 420 ft (61 x 128 m) surface soil contamination area surrounding the 2.3 acres (0.93 ha) fenced burial ground. The volume of buried radionuclide-contaminated soil and debris is approximately 234,666 yd^3 (179,425 m^3). The 1,928-acre (780 ha) area was covered with 6 inches (15 cm) of gravel in 1954, but grass, sagebrush, and other plants have reseeded the area since then.

The BORAX-I reactor was a small experimental reactor used in the summer months of 1953 and 1954 for testing boiling-water reactor technology. In 1954, the design mission of BORAX-I was completed and the decision was made to make one final test, which resulted in the intentional destruction of the reactor. The destruction of the reactor contaminated approximately 84,000 ft^2 (7,804 m^2) of the surrounding terrain. Immediately following the final test of the BORAX-I reactor, much of the radioactive debris, including some fuel residue, was collected and buried on site in the reactor shield tank. Recovered fuel fragments and fuel residue were sent to the Idaho Chemical Processing Plant and Oak Ridge National Laboratory. Reusable equipment associated with the reactor was successfully decontaminated and used in the construction of BORAX-II. However, the cleanup did not sufficiently reduce the radioactivity at the site; therefore, the 1,928 acre (780 ha) contaminated area was covered with approximately 6 in (15 cm) of gravel to reduce radiation levels at the ground surface.

Buried materials at the site consist of unrecovered uranium fuel residue, irradiated metal scrap, and contaminated soil and debris. Part of the waste was buried in the bottom half of the shield tank; the top half of the tank was collapsed into the bottom and the void space was filled with debris. The 222,222 yd^3 (169,910 m^3) burial ground is contained within the foundation of the BORAX-I installation. A mounded gravel and dirt cover approximately 5 ft (1.5 m) high and 30 ft (9 m) in diameter is centered over the buried shield tank. Operable Unit 6-01 includes the buried debris as well as the 1,928-acre (780 ha) of contaminated surface soil.

Field radiation surveys conducted in 1978 and 1980 detected radiation at about three times the background levels in the central portion of the gravel-covered 1,928-acre (780 ha) area south-southeast of the buried reactor. Radiation in adjacent areas was found to be at background levels. Surface and subsurface soil sampling of the 1,928-acre (780 ha) gravel-covered area in 1978 and 1980 indicated that radioactive contamination exists and is highest at a depth of approximately 6 in (15 cm) at the interface of the gravel cover and the original ground surface. Ongoing monitoring of the site through the use of radiation dosimeters shows that radiation levels are slightly above background levels. On November 18, 1994, the radiological field measured at 2.5 ft (0.75 m) above the surface of the BORAX-I burial ground was 0.1 mR/hour; local background radiation was also 0.1 mR/hour.

Today, the ground surface at the site looks very much like the surrounding terrain. Abundant native vegetation has grown over the mound and surrounding area. A 6 ft (1.8 m) high chain-link fence surrounds the burial ground, forming an enclosed area approximately 100 ft (30 m) on each side. A two-wire exclusion fence with posted radiological-control signs, and restricted access to protect INEEL workers and the public from unacceptable exposures, surround the contaminated surface soil area.

Discussion of Issues Leading to the ROD

The SL-1 Burial Ground

The DOE's Radiological and Environmental Sciences Laboratory conducted gamma radiation surveys in the vicinity of Auxiliary Reactor Areas I and II and the SL-1 Burial Ground every 3 to 4 years between 1973 and 1991. The areas north of Auxiliary Reactor Areas I and II and northeast of the SL-1 Burial Ground had the highest gamma radiation intensities. Soil sampling in 1977 found that cesium-137 was the primary contaminant.

The INEEL's Waste Management Group surveyed areas in the vicinity of Auxiliary Reactor Area II and outside of the SL-1 Burial Ground fence in 1985. The survey identified and mapped 236 radioactive particles, of which 219 had maximum surface readings of 20 mR/hour or greater. Of these, 16 had readings greater than 200 mR/hour (the maximum reading possible for the instruments used in the survey). A total of 44 of the particles were removed. Particles with readings greater than 200 mR/hour that were located on the road between Auxiliary Reactor Area H and the burial ground or were located in the disturbed area across Fillmore Boulevard from Auxiliary Reactor Area II were removed.

The BORAX-I Burial Ground

In 1978, the Radiological and Environmental Sciences Laboratory performed a multiphase study to assess the distribution of radioactivity at the BORAX-I reactor Burial Ground. Exposure rates at 3 ft (1 m) above the ground were determined.

A portable gamma-ray spectroscopy system was used to identify gamma-emitting radionuclides. In situ gamma-ray spectrums were obtained from nine locations. Surface-soil samples were also collected at nine locations outside of the graveled area in order to assess the extent of contamination. The collection locations were chosen to include samples down range of the major debris and surface deposition zones. Soil samples were collected from five locations within the gravel-covered area and were analyzed by gamma ray spectroscopy in order to assess the deposition and migration activity. Analyses of the soil samples showed that cesium-137 and uranium-235 were the only detectable gamma-emitting radionuclides present. Samples collected from the gravel covering showed that 98 percent of the radioactive contamination was located within 2 in (5 cm) of the gravel/soil interface.

An investigation of the BORAX-I reactor area was conducted in June and November 1980. The investigation consisted of a radiation survey of the BORAX-I site, including high-resolution gamma spectrometer measurements of the surface soil, soil samples from trenches, and sodium-iodide gamma spectrometer profiles of selected boreholes. The purpose of the radiological characterization was to identify the radionuclides present within the area and to specify their concentrations and distributions. Cesium-137 was the only man-made gamma emitter detected during the radiological surveys. Soil-sample analyses detected cesium-137, strontium-90, uranium-235, and plutonium-239. Results indicate that surface contamination was limited to relatively small areas, mainly along a south-southeast line from the reactor location.

Aerial surveys of the BORAX-I burial ground were conducted in 1974, 1982, 1990, and 1993. The surveys detected gamma radiation from man-made sources in the area, with cesium-137 being the primary contributor.

Summary of Actions Proposed

SL-1
Capital Cost: $1.9 million
Present Worth:
Months of Operation:
O&M:

BORAX-1
Capital Cost: $1.5 million
Present Worth:
Months of Operation:
O&M:

The Idaho National Engineering Laboratory has been subdivided into 10 waste area groups for investigation pursuant to the Federal Facility Agreement and Consent Order between the DOE, EPA, and IDHW. The SL-1 Burial Ground is designated Operable Unit 5-05, one of 13 Operable Units in Waste Area Group 5; the BORAX-I Burial Ground is Operable Unit 6-01, one of five Operable Units in Waste Area Group 6.

The major components of the selected remedial action for both sites are:

- Containment by capping with an engineered barrier constructed primarily of native materials;
- For BORAX-I, implementation will include consolidation of surrounding contaminated surface soils for containment under the engineered cover;
- Contouring and grading of surrounding terrain to direct surface water runoff away from the caps;
- Periodic above-ground radiological surveys following completion of the caps to assess the effectiveness of the remedial action;
- Periodic inspection and maintenance following completion of the caps to ensure cap integrity and surface drainage away from the barriers;
- Access restrictions consisting of fences, posted signs, and permanent markers;
- **Institutional controls;** land only used for industrial applications for at least 100 years following completion of the caps; and
- Review of the remedy no less often than every five years until determined by the regulatory agencies to be unnecessary.

The selected remedy addresses the principal threats posed by the burial grounds by providing shielding from ionizing radiation, a barrier to inhibit ecological and human intrusion, and a long-lasting cover to diminish the effects of wind and water erosion.

Hanford Site, Overview

The U.S. Department of Energy's Hanford Site was listed on the National Priorities List (NPL) in July 1989. On May 15, 1989, EPA, DOE, and the Washington Department of Ecology signed a comprehensive agreement for the cleanup of the entire Hanford Site, including the area covered in this NPL site. This Federal Facility Agreement and State Consent Order contains schedules for remedial investigations and feasibility studies for Superfund work at the Hanford Site.

In 1988, the Hanford Site was scored using EPA's Hazard Ranking System. As a result of the scoring, the Hanford Site was added to the NPL in July 1989 as four sites (the 1100 Area, the 200 Area, the 300 Area, and the 100 Area). The four sites have been included on the EPA's NPL under CERCLA. Under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) signed by the Washington Department of Ecology, EPA, and the DOE, more than 1,000 inactive waste disposal and unplanned release sites have been grouped into a number of source and groundwater Operable Units. These Operable Units contain contamination in the form of hazardous waste, radioactive waste, mixed waste (radioactive and hazardous), and other CERCLA hazardous substances.

Description/History of Site

The Hanford Site was established during World War II as part of the Army's "Manhattan Project" to produce plutonium for nuclear weapons. Hanford Site operations began in 1943 and DOE facilities are located throughout the site and the City of Richland. The land that Hanford now occupies was ceded to the U.S. Government in treaties with the Confederated Bands and Tribes of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation in 1855. Certain portions of the Hanford Site are known to have cultural significance and may be eligible for listing in the National Register of Historic Places.

Summary of Local Physical Conditions

The Hanford Site is a 358,400 acre (145,090 ha) area located in the Pasco Basin, a sediment-filled topographic and structural basin situated in the northern portion of the Columbia Plateau. The Hanford Site is dominated by the low-relief plains of the Central Plains physiographic region and anticlinal ridges of the Yakima Folds physiographic region. The sediments within the Pasco Basin are underlain by the Miocene-age Columbia River Basalt Group, a thick sequence of flood basalts that covers a large area in eastern Washington, western Idaho, and northeastern Oregon.

The land surrounding the Hanford Site is used primarily for agriculture and livestock grazing. The major population center near Hanford is the Tri-Cities, with a combined population of nearly 100,000. The southwestern area of Hanford, covering 76,800 acres (31,081 ha), is the Fitzner-Eberhardt Arid Land Ecology Reserve and is managed by the DOE for ecological research.

Semi-arid land with a sparse covering of cold desert shrubs and drought-resistant grasses dominates the Hanford Site. Forty percent of the area's average annual 6.25 in (15.9 cm) precipitation occurs between November and January.

The Columbia River is the dominant surface-water body on the Hanford Site. The uses of the river include the production of hydroelectric power, extensive irrigation in the Mid-Columbia Basin, and as a transportation corridor for barges. Several communities located on the river rely on it as their primary source of drinking water.

The 100 Area encompasses approximately 26 mi^2 (68 km^2) bordering the south shore of the Columbia River. Pre-Hanford uses included Native American usage and agriculture. Existing land use in the 100 Area includes facilities support, waste management, and undeveloped land. Facilities support includes water treatment and maintenance of the reactor buildings. Ninety percent of the land area within the 100 Area contains minimal infrastructure and has been disturbed very little. An 18-mile stretch of the Columbia River is located within the 100 Area. The shoreline of the Columbia River within the Hanford Site was declared a national monument in June 2000. Portions of the shoreline within the 100 Area are within the 100-year flood plain of the Columbia River. Semi-arid land with a sparse covering of cold desert shrubs and drought-resistant grasses dominates the landscape, with agriculture and livestock grazing outside of the Hanford Site. There are wetlands along the river within the 100 Area, but none are within the area covered by this ROD.

Hanford Site, 100 Area

Site Name:	Hanford 100 Area
ROD:	EPA/ROD/R10-95/126 & 97/044
Site Ownership:	Federal
Site Focus Location:	100-BC-1, 100-DR-1, and 100-HR-1 Operable Units
Contaminant of Concern:	Strontium-90, methylene chloride, acetone, toluene, chromium, mercury, antimony, chrysene, pentachlorophenol, arsenic, lead, and zinc.
Remedy:	The major components of the selected remedial action includes the removal of contaminated soils, structures, and debris using the **"observational approach"** and the **"plug-in approach"**; treatment by thermal desorption to remove organics and soil washing to reduce volume and to meet waste disposal criteria; disposal of contaminated materials at the Environmental Restoration Disposal Facility; and backfill and vegetate excavated areas. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 10 – Washington
Site Size:	16,803 acres (6,800 ha)
Waste Media:	Metal drums, debris, cardboard boxes, clothing, plastic, totaling 4.5 billion yd^3 (3.5 billion m^3) of waste found in cribs, trenches, and burial grounds on site.

Description/History of Site

The Environmental Restoration Disposal Facility (ERDF) is expected to serve as a disposal unit for Hanford remedial waste (primarily soil) for which removal and disposal is the selected remedy. It is anticipated that the ERDF will receive low-level radioactive, hazardous, and mixed waste and small amounts of asbestos and PCB wastes from the 100, 200, and 300 Areas. The total volume of waste is expected to be less than 28 million yd^3 (21.4 million m^3) and is expected to consist of the following contaminated soil, demolition debris (approximately 65 percent to 75 percent), burial ground waste (approximately 15 percent to 20 percent), and wastewater pipelines, ancillary equipment, and associated soil contamination (approximately 10 percent to 15 percent). The scope of the ERDF ROD is focused on the configuration and location of the landfill (also referred to as the trench), the liner, the surface cover, and the operation and closure requirements.

Information on the supporting facilities, including the transportation system, waste handling equipment and procedures, decontamination, and leachate treatment systems, is also presented. These supporting facilities are not the primary focus of this ROD because they do not

significantly affect long-term performance of the facility and are considered design details. They will be fully addressed during remedial design.

Summary of Deposited Wastes

Between 1943 and 1962, nine water-cooled, graphite-moderated plutonium production reactors were built along the shore of the Columbia River upstream from the now-abandoned town of Hanford. Eight of these reactors have been retired from service and will be decommissioned. The ninth reactor, N, was recently shut down and will also be retired. In some of the reactor areas, after the reactor was retired from plutonium production service, the ancillary facilities were used as laboratories for special studies or for storage and treatment purposes.

The total volume of 100 Area waste to be disposed of in the ERDF is estimated to be approximately 9 million yd^3 (7 million m^3). 100 Area waste includes soil, solid wastes, sediments, and sludge. Solid waste encompasses hard waste, soft waste, demolition waste, and pipes. Soft waste includes collapsed cardboard boxes, paper, rags, clothing, plastic, and miscellaneous trash. Hard waste includes aluminum tubes and spacers, failed steel and stainless steel equipment, timbers, and metal drums. Demolition waste includes concrete with and without rebar, steel plate, and timbers. Pipes range from 0.5 to 24 in (1.3 to 61 cm) in diameter. The estimated percentages of the different types of waste are presented below. Estimated distribution of waste in the 100 Area contains 77 percent contaminated soil and 23 percent solid waste.

The principal components of the original eight reactors consisted of the reactor, the reactor cooling water loop, the reactor gas and ventilation system, and the irradiated fuel handling system. During the course of reactor production work, liquid waste disposal sites, solid waste burial grounds, contaminated facilities, and unplanned liquid waste release areas were established.

The 100-BC-1 Operable Unit is one of three Operable Units associated with the 100 Area at the Hanford Site. An estimated 4.3 billion yd^3 (3.3 billion m^3) of solid and dilute liquid waste comprised of radioactive, mixed, and hazardous constituents were disposed in cribs, trenches, and burial grounds in the 100 Area. USDOE has detected hexavalent chromium and strontium-90 in ground water beneath the area; ground water is not used within 3 miles (4.8 km) of the 100 Area, but it is known to seep into the Columbia River in the 100 Area. USDOE detected strontium-90 in the Columbia River at levels significantly above background. Intakes on the Columbia River within 3 miles of the 100 Area supply drinking water to over 3,000 workers in the 100 and 200 Areas.

The ERDF is a large waste disposal facility located in the 200 West Area of the Hanford Site. The facility, which is managed by Bechtel Hanford, Inc., is designed for safe storage of hazardous and mixed waste materials generated from cleanup of the Hanford Site. Only waste from the Hanford Site cleanup is stored at the ERDF. Since the ERDF opened in July 1996, more than 812,179 tons (736,646 metric tons) of contaminated materials have been disposed in the facility. More than 495,829 tons (449,808 metric tons) arrived at the ERDF in fiscal year 1997.

Discussion of Issues Leading to the ROD

DOE, Washington Department of Ecology, and EPA developed a Community Relations Plan (CRP) in April, 1990, as part of the overall Hanford Site restoration. The CRP was designed to promote public awareness of the investigations and public involvement in the decision-making process. The CRP summarizes known concerns based on community interviews. Since that time, several public meetings have been held and numerous fact sheets have been distributed in an effort to keep the public informed about Hanford cleanup issues. The CRP was updated in 1993 to enhance public involvement and is scheduled to be updated again this year.

The 100 Area Focused Feasibility Study Document and Proposed Plans for 100-BC-1, 100-DR-1, and 100-HR-1 were made available to the public on June 26, 1995 in both the Administrative Record and the Information Repositories maintained at Hanford and other public information respoitories.

A fact sheet, which explained the proposed action, was mailed to approximately 2,000 people. In addition, an article appeared in the bimonthly newsletter, the *Hanford Update*, detailing the start of public comment. The *Hanford Update* is mailed to over 5,000 people. The proposed plans were mailed to all of the members of the Hanford Advisory Board.

Summary of Actions Proposed

The selected remedy for the 100 Area NPL Site addresses actual or threatened releases at high-priority liquid radioactive effluent disposal sites at the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units. The major components of the selected remedy include:

- Remove contaminated soil, structures, and debris using the "observational approach" and the "plug-in approach";
- Treatment by thermal desorption to remove organics and soil washing for volume reduction or as needed to meet waste disposal criteria;
- Disposal of contaminated materials at ERDF; and
- Backfill of excavated areas followed by revegetation.

The 100 Area of the Hanford Site is complex and contains many individual waste sites within the area. Based on the circumstances presented by the 100 Area, the use of two innovative approaches to remediation of the individual waste sites will

The **observational approach** relies on information from historical process operations including historical liquid effluent discharges from 1944 to 1969, and from information from field investigations on the nature and extent of contamination, combined with a "characterize and remediate in one step" methodology. This latter methodology consists of contingency planning prior to site excavation and field screening for contaminants. Remediation proceeds until it can be demonstrated through a combination of field screening and conformational sampling that cleanup goals have been achieved.

The **plug-in approach** allows for the selection of the same remedy at multiple, similar or "analogous" sites. In the 100 Area all of the reactor operations, except those in N Area, were virtually identical, leading to very similar releases of contaminants at similarly engineered structures (retention basins, drains, cribs, effluent trenches and pipelines, etc). Limited field investigations at similar sites in different reactor areas has shown similar contaminant characteristics in engineered structures and soils that received liquid discharges. Under this approach a standard remedy is selected that applies to similar circumstances, rather than to a specific waste site.

enhance the efficiency of the selected remedy. The approaches are the **"observational approach"** and the **"plug-in approach"**.

Sites were designated as "high priority" if there were potential risks to human health and the environment. Sites classified as high priority pose risks through one or more pathways sufficient to recommend a streamlined action via an interim remedial measure . Particular emphasis was given to the waste sites addressed in this ROD due to existing or potential adverse impacts to underlying groundwater and subsequent contaminant discharges to the Columbia River. It is expected that some additional sites also will be remediated that are adjacent to and within the area of the high priority sites addressed in this ROD.

This ROD also provides a decision framework to evaluate leaving some contamination in place at a limited number of sites, specifically where contamination begins at depths below 15 ft (4.5 m). The decision to leave wastes in place at such sites will be a site-specific determination made during remedial design and action activities that will balance the extent of remediation with protection of human health and the environment, disturbance of ecological and cultural resources, worker health and safety, remediation costs, operation and maintenance costs, and radioactive decay of short lived [half-life less than 30.2 years (e.g. cesium-137)] radionuclides.

Removing the contaminated materials from areas near the Columbia River to the Hanford Site's central plateau (where ERDF is located) requires a fleet of 18 trucks and 360 waste containers. Each working day, equipment is organized to efficiently deliver waste to the ERDF, a process that logged 6.8 million ton miles (9.92 million metric ton kilometers) in FY97.

Personnel are striving to make remediation, waste disposal, and transportation operation costs for this project the lowest in the entire U.S. Department of Energy complex. The life-cycle cost to dispose materials in the ERDF was $44.90 per ton, a figure that includes construction, transportation, operations, expansion, and closure costs.

After a full year of remedial action and disposal activities, the first of ERDF's two disposal cells are half full. Given the rate at which waste is being disposed and the estimated volume of waste that remains, the plan to expand ERDF was approved. In 1997, the ERDF Record of Decision was amended to authorize expansion of the facility.

Discussion of Amendment to ROD 97/044

Summary of Actions Proposed

Number of Sites	Volume of Disposal (LCY*)	Cost of Site Remediation ($ million)	Cost of Disposal ($ million)	Total ($ million)
37 Initial	535,000	$49	$33	$82
34 Additional	668,000	$71	$41	$112
71 Total	1,203,000	$120	$74	$194

* Loose cubic yards

Remedial actions associated with this ROD are the same remedies used for the previous 95/126 ROD with the exception of a modified remedy described below.

The cleanup goals for the September 1995 interim remedial action ROD and this amendment are to remediate liquid radioactive waste disposal sites to levels that will not preclude any future uses, to protect groundwater in the 100 Area, and to protect the Columbia River. Many of the provisions of the interim remedy as described in the September 1995 interim remedial action ROD and this amendment are the same. The significant differences addressed in this amendment to the September 1995 interim remedial action ROD for the original 37 high-priority sites are explained in the following sections.

Additional radioactive liquid source waste sites exist at the 100 Area NPL site that are analogous to those in the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units selected for the interim remedial action ROD. The boundaries of the remedial action have been expanded to include 34 additional sites within the 100 Area that received discharges of radioactive liquid effluent similar or identical to those that were received by the original 37 high-priority waste sites of the interim remedial action ROD. It was concluded that the 34 additional sites warrant interim remedial action based on the plug-in approach because they all received similar historical discharges of liquid radioactive effluent and the available limited field investigation results indicate elevated risk levels comparable to those of the original 37 high-priority sites.

Estimated remediation costs for the 34 additional 100 Area radioactive liquid waste sites total $112 million. The preliminary cost estimate for the selected interim remedial action (remove, treat as appropriate or required, and dispose) for the original 37 sites was $491 million. Use of less-conservative assumptions and refining the data used in the cost estimating model has reduced this estimate to $82 million. Remediation costs for the total 71 radioactive liquid waste sites of the remedial action ROD and this amendment are projected to be $194 million.

Hanford Site, 300 Area

Site Name:	Hanford 300 Area
ROD:	EPA/ROD/R10-96/143
Site Ownership:	Federal
Site Focus Location:	The 300-FF-1 & 300-FF-5 Process Waste sites
Contaminant of Concern:	Trichloroethene, 1,2-dichloroethene, ammonia, arsenic, benzo(a)pyrene, cadmium, chrysene, PCBs, thallium, tetrachloroethene, cesium-137, chloroform, copper, and nickel
Remedy:	The **final remedy** for 300-FF-1 includes the removal of contaminated soil and debris, the disposal of contaminated material at the ERDF, re-contouring and backfilling the waste sites, followed by re-vegetation and **institutional controls**. The selected interim remedies for 300-FF-5 includes continued groundwater monitoring and **institutional controls**. ***See summary of a summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 10 - Washington
Site Size:	339 acres (135.5 ha)
Waste Media:	27 million yd^3 (20.6 million m^3) of solid and dilute liquid wastes

Description/History of Site

The Hanford 300 Area is adjacent to the Columbia River in the southern section of the 364,800 acre (147,632 ha) Hanford site. Since 1943, Hanford has been the scene of Federal nuclear activities, primarily production of nuclear materials for national defense. In addition, technical support, service support, and research and development related to fuels fabrication also occurred within the 300 Area.

The 300 Area contains a number of support facilities, including a powerhouse for process steam production, a water intake and treatment system for potable and process water, and other facilities necessary for research and development, environmental restoration, decontamination, and decommissioning.

The U.S. Department of Energy fabricates nuclear reactor fuel in the 300 Area, which contains 14 disposal locations. The disposal locations and plumes of contaminated ground water cover approximately 3,200 acres (1,295 ha).

Summary of Deposited Wastes

Activities in the 300 Area have historically been related primarily to the fabrication of nuclear fuel elements. In addition, many technical support, service support, and research and development activities related to fuel fabrication were carried out. As fuel fabrication activities have decreased with the shutdown of the Hanford Site production reactors, research and

development activities in the 300 Area have increased. The newer buildings in the area primarily house laboratory and large test facilities.

The total volume of 300 Area waste to be disposed of in the ERDF has been estimated to be approximately 1.3 million yd^3 (1.0 million m^3). 300 Area waste includes soil and solid wastes. Sites have been grouped into two categories based on similarities of cleanup requirements: (1) contaminated soil; and (2) solid waste (e.g., pipelines, burial ground waste). Estimated distribution of waste in the 300 Area contains 47 percent contaminated soil and 53 percent solid waste.

An estimated 27 million yd^3 (20.6 million m^3) of solid and dilute liquid wastes comprised of radioactive, mixed, and hazardous constituents were disposed of in ponds, trenches, and landfills in the 300 Area. USDOE has detected uranium in area springs, wells, and the Columbia River at levels significantly above background. Almost 70,000 people use ground water and surface water for drinking within 3 miles (4.8 km) of the 300 Area.

The areas of interest which contain radioactive contaminants are the South Process Pond, the Process Trenches, the Landfills, and the Burial Grounds.

The South Process Pond

The South Process Pond is an inactive, unlined surface impoundment in the southern area of 300-FF-1. The South Process Pond was the first disposal facility for liquid process wastes in the 300 Area. These liquid wastes contained uranium, copper, and aluminum, as well as traces of other contaminants, such as VOCs and PCBs. The pond also received slurried ash from the coal-fired powerhouse. It was built in 1943 and was operated until 1975 when it was replaced by the Process Trenches. This pond was originally a single large infiltration basin with the inlet in the southwest corner. In 1948, after the North Process Pond was constructed, the inlet was moved to the northwest corner. In 1951, a dike was constructed across the south end of the pond to form the eastern Ash Pit and the now-retired filter backwash pond. Later, dikes were added to route the flow through the pond. The inlet was in the northwest corner, from which the wastewater flowed through three small settling basins on the west-side of the pond into two larger infiltration basins. The pond had no outlet; water loss was by infiltration and evaporation.

The Process Trenches

The Process Trenches are an inactive RCRA treatment, storage, and disposal unit that will be closed pursuant to the Washington Dangerous Waste Regulations (WAC 173-303). The Hanford Site dangerous waste permit will be modified to incorporate specific permit conditions for this closure. The Process Trenches consist of two parallel, unlined trenches that operated from 1975 to 1994. The two trenches, called the east and west trenches, are separated by an earthen berm. The trenches are located near the western boundary of the 300-FF-1 Operable Unit, approximately 1,000 ft (300 m) west of the Columbia River. The Process Trenches received wastes from the process sewer system, including the low-level radioactive waste from the 307 retention basins. The trenches did not have outlets; water loss was by infiltration and evaporation.

By the late 1980's, the process wastewater contained very little uranium. However, the groundwater still had significantly elevated uranium concentrations. The relatively clean wastewater was mobilizing uranium previously deposited in the bottom of the trenches and carrying it to the groundwater. In 1991, DOE performed an expedited response action (ERA) under CERCLA removal authority at the site. The objective was to move contaminated soils from the south end of the Process Trenches to the dry north end, thus preventing wastewater from passing through the contaminated soil and driving contamination to groundwater. Approximately 14,000 yd^3 (10,800 m^3) was moved in the trenches. The more-contaminated materials were placed in a depression in the northwest corner of the west trench. The-less contaminated material was moved to the north end of the trenches, graded, and covered with a plastic barrier and a layer of clean aggregate. The contaminated sediments were left within the boundary of the Process Trenches and are referred to as the Process Trenches, Spoils Pile. In 1994, a new effluent treatment and disposal facility was started, eliminating discharges to the Process Trenches completely.

Landfills

Landfills 1a, 1b, 1c, and 1d were identified during a review of aerial photographs. Radioactive contamination and debris were found on the surface of Landfill 1a. The materials appeared to be similar to laboratory wastes. Small amounts of what appeared to be "yellowcake" (uranium oxide concentrate) was also found. Landfills 1b and 1c were identified as disturbed or graded areas north of the North Process Pond and near the Columbia River. Landfill 1d was identified as a relatively large burn pit. Historical records indicate that, although some incidental radioactive materials may have been buried in Landfill 1d, the pit was mainly for paper, wood, paint cans, and other debris.

Burial Grounds

A variety of solid wastes, some contaminated with uranium, were disposed in burial grounds or landfills in and around the 300 Area. One burial ground, Burial Ground 618-4, is part of 300-FF-1. The other burial grounds are in 300-FF-2. Burial Ground 618-4 is located in the northwest corner of the Operable Unit. It was used from 1955 through 1961 and is known to contain miscellaneous materials contaminated with radioactive uranium. In 1979, 20 depleted uranium fuel elements were found to be improperly discarded near Burial Ground 618-4. An area of approximately 400 ft^2 (37 m^2) was found to be radioactively contaminated. The elements were removed, along with the contaminated surface soils, and disposed of in the 200 West Area.

The greatest concentrations of uranium-238 (to a maximum of 9,100 pCi/g) were located near the surface at the east trench wire box. Pre-ERA concentrations of uranium-238 were highest near the south end of the trenches, and decreased markedly with distance toward the north end of the trenches. After the ERA, the highest uranium-238 concentration detected (44 pCi/g) was in the west trench at both the surface and at a depth of 4.5 ft (1.4 m), 65 ft (20 m) from the south end of the trench. The post-ERA isotopic uranium data were rejected during data validation because the laboratory was not able to trace the instrument calibration sources were traceable to the National Institute of Standards and Testing, as required by the validation procedure. However, the data were retained for limited use.

Thorium-228 concentrations in pre-ERA soils in both the cast and west trenches ranged from 0.52 pCi/g to a maximum of 17 pCi/g. The maximum was detected at a depth of 0.5 ft (0.15 m) in the east trench. Post- ERA concentrations ranged from below the detection limit at a depth of 11 ft (3.3 m) in VPT-1 to a maximum of 0.83 pCi/g at the 6.5 ft (2 m) interval in the same test pit, within the range of the apparent site background.

Discussion of Issues Leading to the ROD

DOE, Ecology, and EPA developed a Community Relations Plan in April 1990 as part of the overall Hanford Site restoration. This plan was designed to promote public awareness of the investigations, as well as public involvement in the decision-making process. The plan summarizes known concerns based on community interviews. Since it was originally written, several public meetings have been held and numerous fact sheets have been distributed in an effort to keep the public informed about Hanford cleanup issues. The plan was updated in 1993 to enhance public involvement and it is currently undergoing an additional update.

The RI/FS reports and the proposed plan for 300-FF-1 and 300-FF-5 were made available to the public in both the Administrative Record and the Information Repositories maintained at the locations listed below. These documents were offered for a 45-day public comment period from December 4, 1995, to January 17, 1996. During that time, an extension of the comment period was requested. The public comment period was subsequently extended to February 9, 1996. The 300 Area Process Trenches Closure Plan and Groundwater Monitoring Plan were also made available for review.

Summary of Actions Proposed

Capital Cost: $60 million
Present Worth:
Months of Operation: 100 years
O&M: $28.7 million

This ROD addresses actual or threatened releases from the waste sites in the 300-FF-1 Operable Unit and the groundwater in the 300-FF-5 Operable Unit. 300-FF-1 and 300-FF-5 are two of the three Operable Units that compose the USDOE Hanford 300 Area National Priorities List site. The third Operable Unit (300-FF-2) consists of the remaining waste sites in the 300 Area NPL site and any associated groundwater that is not part of 300-FF-5. Actual or threatened releases from the waste sites and the groundwater in 300-FF-2 will be addressed in a future ROD. The major components of the selected final remedy for 300-FF-1 include:

- Removal of contaminated soil and debris;
- Disposal of contaminated material at the Environmental Restoration Disposal Facility;
- Re-contouring and backfilling of waste sites, followed by re-vegetation;
- **Institutional controls** to ensure that unanticipated changes in land use do not result in unacceptable exposures to residual contamination.

The selected remedy for 300-FF-5 is an interim **remedial action** that involves **imposing restrictions on the use of the groundwater** until such time as health-based criteria are met for

uranium, trichloroethene, and 1,2- Dichloroethene. This is an interim action because there are other constituents (e.g., tritium) that are migrating into 300-FF-5 that have not yet been fully addressed and because a portion of 300-FF-5 is overlaid by uncharacterized waste sites in 300-FF-2. A final remedial action decision for 300-FF-5 will be made after these issues have been addressed.

The selected **interim remedy** includes:

- **Continued monitoring** of groundwater that is contaminated above health-based levels to ensure that concentrations continue to decrease;
- **Institutional controls** to ensure that groundwater use is restricted to prevent unacceptable exposures to groundwater contamination.

The selected remedies for 300-FF-1 and 300-FF-5 include Alternative P-3 (selective excavation and disposal of contaminated soil and debris from the process waste units), Alternative B-3 (Excavation and Removal of Burial Ground 618-4), and Alternative GW-2 (**institutional controls** for groundwater). When compared with other alternatives, the selected remedies provide the best overall protection of human health and the environment at a reasonable cost. The selected remedies facilitate the reuse of the sites for other industrial uses. The total estimated cost of the remedies is $28.7 million.

The immediate cost of implementing **institutional controls** for the groundwater is very low. Most of the cost is associated with monitoring; therefore, this alternative is only slightly more expensive than no action. The remaining alternatives are significantly more expensive.

Hanford Site, 300 Area Transuranic Burial Grounds

Site Name:	300 Area Transuranic Burial Grounds
ROD:	Not yet issued
Site Ownership:	Federal
Site Focus Location:	618-10 and 618-11 TRU Burial Grounds (300-FF-2 Operable Unit)
Contaminant of Concern:	Pu fission products, other TRU constituents, Pu metal, Pu nitrate, organics and heavy metals
Remedy:	**Proposed remedy** is Remove-Treat-Dispose with institutional controls. ***See summary of actions proposed for this in-progress ROD for further detailed information.***
EPA Region:	Region 10 – Washington
Site Size:	618-10 Burial Ground: 5.7 acres (2.3 ha) 618-11 Burial Ground: 8.6 acres (3.5 ha)
Waste Media:	Solid and liquid wastes, contaminated equipment, soil

Description/History of Site

Like each of the NPL sites at the Hanford Site, the 300 Area was divided into Operable Units (OUs), which are groupings of individual sites based primarily on geographic area and common waste sources. The 300 Area consists of three OUs. The 300-FF-1 and the 300-FF-2 OUs address contamination at burial grounds and soil waste sites. The 300-FF-5 OU addresses groundwater contamination beneath the burial grounds and soil waste sites.

The foci of this summary are the 618-10 and 618-11 Burial Grounds, which operated between 1954 and 1967. The grounds were used to the disposal of pre-1970 transuranic-contaminated waste. This waste was placed in pipe units and trenches, and also in caissons in 618-11. The 618-11 Burial Ground was evaluated via an environmental impact statement in 1987. This EIS is used as the basis for estimating waste quantities and consequent remediation costs for both 618-10 and 618-11, as discussed below.

Summary of Deposited Wastes

There is little quantified, verifiable data regarding the types and volumes of wastes contained within 618-10 and 618-11. Recently constructed documents based on historical records all acknowledge that records are incomplete and that the quantities given are estimates. As a result, these documents are often found to be contradictory. Areas of uncertainty include volumes of waste deposited in caissons, vertical pipe units, and trenches (e.g., the percentage of TRU waste in trenches has been estimated at between 20 percent and 100 percent depending on the source used) and types of waste deposited (low-level, contact-handled TRU waste, remote-handled TRU

waste, mixed waste). Information presented here should be considered with the above information in mind.

618-10 Burial Ground

The 618-10 Burial Ground contains at least 12 trenches and 94 vertical pipe storage units on 5.7 acres (2.3 ha). The trenches range in size from 320 ft long by 70 ft wide (97.5 m by 21.3 m) to 50 ft long by 40 ft wide (15.2 m by 12.2 m). The bottoms of the trenches are estimated to be approximately 25 feet (7.6 m) below grade. The vertical pipe storage units, each constructed from five 55-gallon drums welded together end to end, are approximately 15 feet (4.6 m) long by 22 inches (0.559 m) in diameter. The bottoms of the vertical pipe units are estimated to be 20 feet (6 m) below grade. The vertical pipe units are bottomless, and were capped with concrete and covered with dirt as they were filled with waste.

Current assumptions regarding the quantity of waste within these trenches and vertical pipe units are as follows:

- Because of the scattered nature of the numerous trenches and vertical pipe units, waste volume estimates use the overall burial ground dimensions for estimating purposes;
- 50 percent of the total volume is considered contaminated, with the other 50 percent considered to be clean material; and
- Vertical pipe units are 80 percent full and are structurally sound.

Using these assumptions, the waste volume for the 618-10 Burial Ground is estimated at 127,701 yd^3 (97,634.1 m^3). Of this, 127,563 yd^3 (97,528.8 m^3) is contained within the trenches, and 110 yd^3 (82.2 m^3) is contained within the vertical pipe units. From this information, the following assumptions are used to calculate the volume of TRU waste within the 618-10 Burial Ground:

- 10 percent of the pipe unit waste volume is remote-handled TRU;
- 90 percent of the pipe unit waste volume is low-level mixed waste; and
- 100 percent of the trench contaminated volume is low-level mixed waste.

These assumptions result in the following volumes of waste within 618-10:

	RHTRU (yd^3/m^3)	LLMW (yd^3/m^3)
Vertical Pipe Units	11/8.4	99/75.8
Trenches	0/0	127,563/97,528.8
Total	11/8.4	127,662/97,604.6

618-11 Burial Ground

The 618-11 Burial Ground contains three trenches, each 900 ft (274.3 m) long by 50 ft (15.2 m) wide by 15 ft (4.6 m) deep, with an additional 5 ft (1.5 m) of overburden. The Burial Ground also contains 54 vertical pipe units (of dimensions identical to those found in the 618-10 Burial Ground) and four caissons. The caissons are constructed of corrugated steel with a diameter of 8 ft (2.4 m) and a height of 10 ft (3 m), with a volume of 18.6 yd^3 (14.2 m^3).

Current assumptions regarding the quantity of waste within the 618-11 Burial Ground are as follows:

- Due to the presence of only (40 to 50 ft) between each of the trenches, the entire area of the three trenches is used;
- Contaminated volume= (133,611 yd^3/102,153 m^3);
- Uncontaminated volume= (71,284 yd^3/54,501 m^3);
- Vertical pipe units are 80 percent full and are structurally sound; and
- Caissons are 80 percent full.

Using these assumptions, the waste volume for the 618-11 Burial Ground is estimated at 3,610,816 ft^3 (102,247 m^3). Of this, 133,611 yd^3 (102,153 m^3) is contained within the trenches, 63.3 yd^3 (48.4 m^3) is contained within the vertical pipe units, and 59.6 yd^3 (45.5 m^3) is contained within the caissons. From this information, the following assumptions are used to calculate the volume of TRU waste within the 618-11 Burial Ground:

- 100 percent of vertical pipe unit waste volume is remote-handled TRU;
- 100 percent of caisson waste volume is remote-handled TRU;
- 10 percent of trench contaminated volume is contact-handled TRU; and
- 90 percent of trench contaminated volume is LLMW.

These assumptions result in the following volumes of waste within 618-11:

	HTRU (yd^3/m^3)	CHTRU (yd^3/m^3)	LLMW (yd^3/m^3)
Vertical Pipe Units	63.3/48.4	0/0	0/0
Caissons	59.6/45.5	0/0	0/0
Trenches	0/0	13,346.5/10,203.6	120,112/91,832
Total	122.9/93.9	13,346.5/10,203.6	120,112/91,832

Discussion of Issues Leading to the (yet-to-be-issued) ROD

The 200-FF-2 OU is one of three OUs associated with cleanup of the 300 Area NPL site. Cleanup actions for the 300-FF-1 and 300-FF-5 OUs are underway in accordance with an associated ROD. The objective of the 300-FF-2 OU is to prevent or reduce potential future threats to human health and the environment.

As with other remedial actions at Hanford, the 300 Area ROD that will deal with the 618-10 and 618-11 Burial Grounds is rooted in the protection of human, worker, and environmental health. This ROD will address radioactively and/or chemically contaminated soil, buried waste, below-ground structures at sites in the 300 Area and in the general vicinity of the 300 Area. Waste sites that will be covered by this ROD will have been identified through a categorization process developed and implemented by the Tri-Parties (to include the U.S. Environmental Protection Agency, the U.S. Department of Energy, and the Washington State Department of Ecology). The categorization process to date has resulted in identification of 56 waste sites (including the two TRU waste sites that are the focus of this summary) that require remedial action under CERCLA.

In addition to the 56 waste sites that require remedial action, 20 waste sites were identified through the categorization process as "candidates" (candidate sites) for remedial action. The candidate sites require additional characterization to determine if remedial actions are warranted. Pursuant to the results of additional sampling, these sites may be added to the scope of the 300-FF-2 OU at a later point in time through the use of the "plug-in" approach.

To determine the risk to human and ecological receptors, a generic conceptual site model for the 300-FF-2 OU was developed to illustrate how contaminants are transported between media and to identify exposure pathways of concern. A modified risk assessment approach was adopted that limits the pre-remediation studies sothat more resources can be allocated to the cleanup of the waste sites. This conceptual site model takes into account the 300 Area's proposed post-remediation industrial use, which was determined by extensive and ongoing dialogue with numerous stakeholders.

Remedial action objectives (RAOs) for the 300-FF-2 OU were developed based on this anticipated future land use, the conceptual site model, ARARs, and worker safety. These RAOs include:

1. Prevent or reduce risk to human health, ecological receptors, and natural resources associated with exposure to wastes or soil contaminated above ARARs or risk-based criteria.
2. Prevent migration of contaminants through the soil column to groundwater and the Columbia River.
3. Prevent or reduce occupational health risks to workers performing remedial action.
4. Minimize the general disruption of cultural resources and wildlife habitat, and prevent adverse impacts to cultural resources and threatened or endangered species.
5. Provide conditions suitable for future industrial land use of the 300 Area.
6. Ensure that appropriate institutional controls and monitoring requirements are in place to protect future users at a remediated site.

Preliminary remediation goals (PRGs) have been developed for a comprehensive list of contaminants of potential concern to establish residual soil concentrations for individual contaminants that are protective of human health and the environment at a generic waste site. Following public comment, the PRGs will be issued in the ROD for the 300-FF-2 OU as remediation goals, or cleanup levels.

Summary of Actions Proposed

Capital Cost:	$367.4 million*
Present Worth:	$369.5 million*
Months of Operation:	12,000+
O&M:	$2.1 million*

* Due to uncertainties associated with excavation and processing of TRU-contaminated waste, the costs presented here are considered to be rough order of magnitude estimates.

For the 618-10 and 618-11 Burial Grounds, three remedial alternatives have been considered. They are:

- The 'No Action' baseline;
- Remove, Treat, and Dispose: Removal, treatment as necessary, disposal at an engineered facility such as the ERDF or WIPP, and implementation of institutional controls and groundwater monitoring; and
- Containment: Construction of an engineered surface barrier and implementation of institutional controls and groundwater monitoring.

Of these alternatives, the Tri-Parties believe that implementation of the Remove, Treat, and Dispose alternative (the preferred alternative) would satisfy the statutory requirements for protection of human health and the environment, compliance with ARARs, cost-effectiveness, utilization of permanent solutions to the maximum extent practicable, and indicate a preference for treatment as a principal element of the remedy.

There are both common and site-specific elements of the RTD alternative for the 300-FF-2 OU. The common elements will be presented here first, followed by the elements specific to the 618-10 and 618-11 Burial Grounds.

Common Elements of the RTD Alternative

Response Action. The primary element of the RTD alternative involves complete source removal, treatment as necessary, and disposal at an engineered facility such as the ERDF or WIPP. The RTD alternative assumes an excavation depth sufficient to meet all RAOs, including protection of the groundwater and the Columbia River. An observational approach would be used to guide the cleanup operation. Application of water and/or crusting agents would be used for dust control.

The RAO for direct exposure applies only to the upper part of the soil column, which is defined as the top 4.6 m(15 ft) of soil below the surrounding grade or the bottom of the engineered structure, whichever is deeper. The RAOs for protection of groundwater and the Columbia River must be met through the entire soil column from the surface to the groundwater. It is anticipated that all of the RAOs would be achieved at depths of less that 15 ft (4.6 m) at many of the 300-FF-2 OU waste sites because records indicate that the contamination is shallow.

If residual contamination exceeding cleanup standards is found below 15 ft (4.6 m), the extent of remediation may require reevaluation by the Tri-Parties. A decision to continue excavation would depend on the nature/type of waste, worker safety, cost, estimated volume, and impacts to cultural/ecological resources. Alternatives to continued excavation could include institutional controls, continued monitoring, evaluation of other response actions (e.g., subsurface barriers), or waivers from cleanup standards. Any decisions to leave contaminants in place that exceed RAOs below 15 ft (4.6 m) will be made by the Tri-Parties and may require public comment depending on the nature of the waste.

Contaminated soil and debris would be transported to an engineered facility such as the ERDF for disposal. A small percentage of the waste may require treatment prior to disposal in the

ERDF or shipment to permitted offsite disposal facilities. Clean overburden soil would be stockpiled at the site and used as backfill when site remediation is completed. As needed, additional backfill would be obtained from onsite borrow pits. Remediated areas would be graded to match local area contours and revegetated or paved.

Institutional Controls. Institutional controls would be required during and after an RTD response action to ensure that future land use remains consistent with the industrial scenario. Physical methods of precluding unintentional trespassing and controlling access to waste sites could include signs, entry control, excavation permits, artificial or natural barriers, and active surveillance. Legal restrictions on the use of land and groundwater would be imposed through land-use restrictions and/or enforceable covenants and would be effective if control of a site is transferred from DOE to another party.

Groundwater Monitoring. Groundwater monitoring and any required remedial actions would be performed as part of the 300-FF-5 groundwater OU. Any information on the nature and extent of contamination at 300-RR-2 OU waste sites that is gathered during implementation of the RTD alternative would be factored into future 300-FF-5 OU groundwater monitoring activities and remedial actions.

Rationale and Special Considerations for RTD of the 618-10 and 618-11 Burial Grounds

The preferred remedy for the 618-10 and 618-11 Burial Grounds is the RTD alternative. Although containment of these two burial ground sites was also shown to be protective at a lower cost, the RTD alternative provides a higher degree of long-term effectiveness and permanence through removal of contaminants to the extent that direct exposure, groundwater, and river pathways are protected. The proposal to implement the RTD alternative for the 618-10 and 618-11 Burial Grounds is consistent with a DOE desire to consolidate the pre-1970 buried transuranic-contaminated wastes to the 200 Area plateau. The preference of the RTD alternative is also consistent with the selected remedy for the 300-FF-1 OU Burial Grounds.

The estimated present-value cost for implementation of the RTD alternative at the 618-10 and 618-11 Burial Grounds is $369.5 million (including capital cost and O&M costs). Approximately 80 percent of the present-value cost for the two sites is based on unit estimates from DOE waste management sources for disposal of each drum of TRU-contaminated waste. Historical records and information on the quantity and type of materials that were disposed at these burial grounds are incomplete, published as estimates, and often contradictory depending on the source. Consequently, there is a high level of uncertainty associated with the cited cost estimates.

The excavation and subsequent management of TRU-contaminated waste will present challenges and require complex technologies to ensure protection of workers and the public during remediation. Excavation, retrieval, characterization, treatment, packaging, and transportation technologies for TRU-contaminated waste have yet to be fully developed at DOE-managed sites across the country. Within the past several years, the issues associated with TRU-contaminated waste have been recognized and are now being addressed on a larger scale. The program is still relatively new, and no definitive solutions have been established other than to identify the WIPP

as a final disposal site. At the Hanford Site, retrieval and treatment of this type of waste will be addressed as part of the Tri-Party Agreement M-91 milestone series.

Due to these complexities, remediation of the 618-10 and 618-11 Burial Grounds is not anticipated to begin until sometime after 2010. The excavation, retrieval, characterization, treatment, packaging, and transportation technologies established through development efforts at the Hanford Site and other DOE-managed sites will be used to help prepare remediation plans for the 618-10 and 618-11 Burial Grounds. In the meantime, access restrictions, maintenance of existing cover systems, and environmental monitoring will be continued at the two burial ground sites to ensure interim safety of the burial grounds and protection of the public and environment.

In the future, the Tri-Parties will review the 618-10 and 618-11 Burial Ground remediation plans using the information obtained through technology development efforts. If new information suggests a change to the remedy selected for these two Burial Grounds, the remedy change would be documented in an amendment to the ROD. The process of issuing a ROD amendment would require public involvement.

Hanford Site, 100 Area

Site Name:	Hanford 100 Area
ROD:	EPA/541/R-99/112
Site Ownership:	Federal
Site Focus Location:	100-BC-1, 100-BC-2, 100-DR-1 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units
Contaminant of Concern:	Carbon-14, Cesium-137, Cobalt-60, Europium-152, Europium-154, Nickel-63, Silver-108m, Strontium-90, and Tritium (H-3)
Remedy:	The major components of the selected remedial action includes the removal of contaminated soils, irradiated reactor hardware and other solid wastes associated with reactor operations. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 10 – Washington
Site Size:	26 mi^2 (68 km^2)
Waste Media:	Soil, structures, and associated debris.

Description/History of Site

The 100 Area contains burial grounds, contaminated soils, structures, and debris. This ROD does not does not address groundwater already contaminated by this site. Waste-site-specific Qualitative Risk Assessments, comprised of human health risk assessments and ecological risk assessments were conducted to evaluate current and potential effects of contamination on human health and the environment.

Cleanup of waste sites in the 100 Area began in 1995. Burial grounds waste site remediation will be integrated into the current remediation schedule. It is expected to take a minimum of 10 years to complete cleanup of all the source waste sites in the 100 Area NPL site.

Summary of Deposited Wastes

All of the 100 Area single pass reactor operations were virtually identical, leading to similar releases of contaminants. The predominant contaminants of potential concern are radionuclides contained in hard wastes (greater then 99 percent metallic), with the exception of burial grounds in the 100-F Area that contain radiologically-contaminated soft wastes from biological studies. The major radiological constituents in the burial grounds are tritium, carbon-14, cobalt-60, nickel-63, strontium-90, silver-108m, cesium-137, europium-152, and europium-154. Hard metallic wastes may include lead, boron, cadmium, cobalt, and nickel-containing equipment. Asbestos is assumed to exist at the site as well.

Radioactive material is believed to be contained in 27 of the 45 100-Area burial ground sites. Risks to human health, in the form of increased cancer risks, and risks to the area ecology are found though the soil, wind-blown dust, and external exposure to radiation.

Discussion of Issues Leading to the ROD

DOE, Washington Department of Ecology, and EPA developed a Community Relations Plan (CRP) in April, 1990 as part of the overall Hanford Site restoration. The CRP was designed to promote public awareness of the investigations and public involvement in the decision-making process. The CRP summarizes known concerns based on community interviews. Since that time several public meetings have been held and numerous fact sheets have been distributed in an effort to keep the public informed about Hanford cleanup issues. The CRP was updated in 1993 to enhance public involvement and is scheduled to be updated again this year.

The *Proposed Plan for Interim Remedial Actions for the 100 Area Burial Grounds* and the *Focused Feasibility Study* were made available to the public in both the Administrative Record and the Information Repositories on May 22, 2000.

A fact sheet, which explained the proposed action, was mailed to approximately 2,000 people. In addition, an article appeared in the bimonthly newsletter, the *Hanford Update*, detailing the start of public comment. The Hanford Update is mailed to over 4,000 people. A public meeting was held on June 15, 2000 in Hood River, Oregon, to discuss the cleanup, and a public comment period was held from May 22 to June 20, 2000.

The 100 Area is being considered for the following unrestricted uses after cleanup, although the groundwater issue is not covered in this ROD: Native American uses; Limited recreation, recreation-related commercial use, and wildlife use; B Reactor as a museum and visitor center; wildlife and recreational use.

Summary of Actions Proposed

Capital Cost:	$ 702.171 million
Present Value:	$ 556.289 million
Months of Operation:	12,000 (1,000 years)
O&M:	$ 1,788.909 million

The selected remedy for 100 Area Burial Grounds waste sites will include the following activities.

- Submit a new or revised Remedial Design Report to EPA for approval prior to initiation of remediation;
- Necessary removal and stockpiling of any uncontaminated overburden used for backfilling of excavated areas;
- Excavation and transportation of contaminated soils, structures, and debris;
- Treat, as necessary, waste materials with macroencapsulation before disposal;
- For shallow sites (where contamination is present within the top 14 feet) excavation may cease when contaminant levels are demonstrated to be at or below

MTCA method B for inorganics and organics for residential exposure For radionuclides, the EPA CERCLA risk range of 10^{-4} to 10^{-6} needs to be achieved;

- For contamination extending below 15 feet, the site will be remediated to achieve RAOs such that contaminant levels are the same as for the requirements for shallow sites;
- Once cleanup levels are achieved, backfill and revegetation will be conducted. Revegetation plans will be developed as part of the remedial design activities with input from affected stakeholders such as National Resource Trustees and Native American Tribes;
- Institutional controls will be enacted for the interim action. Any additional controls will be specified as part of the final remedy. DOE will continue to use a "badge in" program to control access, well drilling is prohibited, groundwater use is prohibited, no intrusive work is allowed on or near the waste sites, signs will warn river users of potential hazards, as well as "No Trespassing" signs along the shoreline and access roads. Trespass will be reported to the Sheriff's office;
- A 5-year review is required; and
- A sitewide institutional control plan is required that includes the 100 Area Operable Units. This is due to the EPA by July 2001.

Maxey Flats Nuclear Disposal, Operable Unit 1

Site Name:	Maxey Flats Nuclear Disposal
ROD:	EPA/ROD/R04-91/097
Site Ownership:	Federal
Site Focus Location:	OU 1
Contaminants of Concern:	Pu-238, Pu-239/240, Am-241
Final Remedy:	This final remedy substantially controls and reduces site risks to an acceptable level through treatment, engineering and **institutional controls**, and containment. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 4 - Kentucky
Site Size:	280 acres (113 ha)
Waste Media:	Solid and solidified-liquids, containerized and loose, containing radionuclides, organics, and inorganics 175,926 yd^3 (113,272 m^3)

Overview

The 280 acre (18.2 ha) Maxey Flats Nuclear Disposal site is an inactive low-level radioactive waste disposal facility in Fleming County, Kentucky. Land use in the area is predominantly agricultural and residential with mixed woodlands surrounding the site. From 1962 to 1977, Nuclear Engineering Company, Inc. (NECO), operated a solid by-product, source, and special nuclear material disposal facility under a license from the state of Kentucky. Activities at the site have resulted in significant movement of waste-laden ground and surface water away from the waste trenches.

Description/History of Site

The 45 acre (2.9 ha) restricted area within the Maxey Flats Disposal Site (MFDS) contains 52 unlined trenches, storage and warehouse buildings, liquid storage tank buildings, gravel driveways and a parking area. For information on the history of the site (as relevant to the ROD summarized here), please see "Discussion of Issues Leading to the ROD" below.

Summary of Local Physical conditions

Land use surrounding the Maxey Flats Disposal Site consists primarily of a few small farms and some small commercial establishments. The surrounding land area is 40 percent farm land and 50 percent mixed woodlands. The final remedy for the MFDS include procurement of a **buffer zone** adjacent to the existing site property boundary, estimated to range from 200 to 400 acres (81 to 162 ha), for the purpose of preventing deforestation of the hill slopes or other activities which would accelerate hill slope erosion and affect the integrity of the selected remedy, and to

provide for frequent and unrestricted access to areas adjacent to the site for the purpose of monitoring the site.

Maxey Flats is located in the Appalachian Plateau, in the Knobs physiographic region of northeast Kentucky. The subsurface is defined by fractured shales, siltstones, and sandstones. A siltstone bed intersects the majority of the waste trenches at depths ranging from 15 to 25 feet (4.6 to 7.6 m). Vertical migration of fluids is limited by layers of shale with low permeability, which act as aquitards. Soil cover in the area ranges from 0.5 to 18 ft (0.15 to 5.5 m) thick, with an average of 5 ft (1.5 m). There are several surface water features at the site. There is no mention in the ROD of an aquifer.

Summary of Deposited Wastes

Low-level radioactive waste was disposed of in MFDS' 52 large, unlined trenches, some of which measure 680 x 70 x 30 ft deep (207.3 x 21.3 x 9.1 m). These trenches cover approximately 27 acres (11 ha) of land within the 45 acre (18.2 ha) restricted area. When a trench was taken out of active service, fill material (soil), typically 3 to 10 ft (0.9 to 3 m) in thickness, was placed over the trenches to serve as a protective cover. "Hot wells" were also used at the MFDS for burial of small volumes of high specific activity waste. Most of the "hot wells" are 10 to 15 ft (3 to 9.6 m) deep and are constructed of concrete, coated steel pipe or tile, and capped with a large slab of concrete.

The remedial investigation estimated that a total of approximately 2.8 million gallons (10.6 million liters) of leachate are in the disposal trenches. The remedial investigation, including the previous investigations, concluded that there is a large range of contaminant concentrations in samples collected from trenches in different parts of the restricted area. Additionally, site records indicate that samples (tritium and gross alpha and beta particle analyses) from the same trench sump yield varying concentrations at different times.

Most of the waste disposed of at the MFDS was in solid form, although some container-enclosed liquids and solidified liquid wastes were accepted during the earlier years of site operation. The wastes were in a variety of containers including cardboard or fiberboard boxes, wooden crates, shielded drums or casks, and concrete blocks. Low specific activity wastes that were buried in the restricted area include paper, trash, cleanup materials and liquids, packing materials, protective apparel, plastics, laboratory glassware, obsolete equipment, radiopharmaceuticals, animal carcasses, and miscellaneous rubble.

Higher activity wastes buried in the restricted area included sealed sources, irradiated reactor parts, filters, ion-exchange resins, and shielding materials.

Transuranic waste, generally associated with glove boxes, gaskets, plastics, rubber tubing, paper, and rags was also disposed of at the MFDS.

Information on the types and quantities of chemical wastes buried at the MFDS was generally not recorded at the time of waste burial. However, some radioactive shipment records note the disposal of liquid scintillation vials, which generally contain a solvent and a radioactive

constituent. The principal hazardous organic constituents associated with liquid scintillation fluids are toluene and xylene.

The total volume of waste buried at the MFDS has been estimated at approximately 177,777 yd^3 (135,926 m^3). Of this volume, the activity of by-product material alone (material that has become radioactive by neutron activation in reactors) disposed of at the MFDS has been estimated at 2.4 million curies. Much of this material was reported as mixed fission products; thus, the total activity from by-product waste may be underestimated. Other wastes disposed of at the MFDS include special nuclear material (Pu-238, U-233, and enriched U-235) and source material (uranium and thorium, not including classified nuclear material).

In addition to the wastes received from off-site, on-site operations have generated solid wastes; these have been disposed of in newly-constructed trenches within the site's restricted area.

Discussion of Issues Leading to the ROD

Environmental monitoring by the Kentucky Department of Health in 1972 revealed possible migration of radionuclides from the restricted area. The monitoring indicated that water entering the trenches had become the pathway by which radioactive contaminants, primarily tritium, were beginning to migrate from the disposal trenches. A special study of the site was conducted by the Commonwealth of Kentucky in 1974 to determine whether the MFDS posed any contamination problems. The study confirmed that radioactive contaminants were migrating from the trenches and that some radioactive material had migrated into unrestricted areas. Various other studies of the MFDS were initiated during the 1970s and 1980s by Federal and State agencies.

During construction of Trench 46 in 1977, it was determined that leachate was migrating through the subsurface geology at depths down to 25 ft (7.62 m) below the surface. Subsequently, the Commonwealth ordered NECO to cease the receipt and burial of radioactive waste; NECO's 25-year contract/lease was terminated in 1978, and its license transferred to the Commonwealth in 1979. At that time, private companies were hired to stabilize and maintain the site. These activities included the installation of temporary covers over the trench disposal area, surface water control, and subsidence and contaminant monitoring.

An evaporator was operated at the site from 1973 through 1986 as a means of managing the large volumes of water infiltrating the disposal trenches and site-generated wastewater. The evaporator processed more than 6 million gallons of liquid (22.7 million liters), leaving behind evaporator concentrates that were stored in on-site, above-ground tanks. These concentrates were eventually disposed on in Trench 50.

In 1981, a polyvinylchloride (PVC) cover was placed over the disposal trenches as a means of minimizing the infiltration of rainfall into the trenches.

At the request of the Commonwealth in 1983, EPA began the process of determining whether the MFDS would be eligible for remediation under CERCLA. In 1984, EPA proposed the MFDS for inclusion on the NPL. This listing was finalized in 1986.

In 1986, EPA issued general notice letters to 832 potentially responsible parties (PRP) of their potential liability with respect to site contamination and offering them an opportunity to conduct and fund a RI/FS. In 1987, 82 PRPs signed an Administrative Order by Consent to perform the RI/FS and formed the Maxey Flats Steering Committee. This Committee has conducted and partially funded the technical work required for the RI/FS performed at the site. The largest portion of the cost incurred was paid by DOD and DOE (both named as PRPs, but not members of the Committee).

In 1988, EPA notified the PRPs of an imminent threat to public health, welfare, and the environment posed by the potential release of liquids in the on-site storage tanks, which had deteriorated to an unstable condition. The PRPs declined the offer to participate in the removal of these tanks; thus, EPA initiated phase one of the removal in late 1988. Phase two of the removal was initiated by EPA in mid-1989. This phase entailed the solidification of approximately 286,000 gallons (1.08 million liters) of radioactive liquid. This was completed in late 1989, and resulted in the generation of 216 blocks of solidified liquids. These blocks were disposed of in a newly-constructed trench within the MFDS restricted area.

The remedial investigation report for the MFDS was approved by EPA in July 1989. The feasibility study for the MFDS was finalized and, along with the administrative record file for the site, was submitted to the public in May 1991.

Summary of Actions Proposed

Present Worth:	$33.553 million
O&M:	$10.1 million
Months of Operation:	22 (for initial closure)
	420-1200 (for interim maintenance period following initial closure)
	10 (for final closure period following interim maintenance period)
	∞ (for the custodial maintenance of the site following final closure)

The objectives of the final remedy are summarized here:

- Minimize the infiltration of rainwater and groundwater into the trench areas and minimize the migration from the trenches;
- Stabilize the site such that an engineered cap that will require minimal care and maintenance over the long term can be placed over the trench disposal area;
- Minimize the mobility of trench contaminants by extracting trench leachate to the extent practicable;
- Promote site drainage and minimize potential for erosion to protect against natural degradation;
- Implement **institutional controls** to permanently prevent unrestricted use of the site; and
- Implement a site performance and environmental monitoring program.

The final remedy for the Maxey Flats site addresses four timeframes: the initial closure period, an interim maintenance period, the final closure period, and the custodial maintenance period. The activities to be undertaken during these four times are shown here:

Interim closure period

- Baseline topographic surveys;
- Geophysical surveys;
- Groundwater monitoring;
- Groundwater modeling;
- Trench leachate extraction and solidification;
- Disposal of solidified leachate into new trenches on-site;
- Demolition of existing buildings and structures with on-site disposal;
- Installation of an initial cap;
- Grading and recontouring of the initial cap to enhance surface water flow;
- Improvement to site drainage;
- Installation of subsidence monitors;
- Closure of selected, poorly designed, historical wells;
- Monitoring, maintenance, and surveillance;
- Procurement of a **buffer zone** contiguous to the existing site property;
- Posting and repairing of signs and fences, and road maintenance; and
- Development of the interim site management plan.

Interim maintenance period

- Periodic topographic surveys and subsidence monitoring;
- Maintenance of the initial cap;
- Continuing assessment of the adequacy of the initial cap, surface water control measures, and erosion control measures;
- Improvements to site drainage features, as needed;
- Trench leachate management and monitoring;
- Monitoring, maintenance, and surveillance;
- Enhanced groundwater monitoring;
- Installation of a new horizontal flow barrier, as required; and
- Five year reviews.

Final closure period

- Waste burial;
- Installation of final cap;
- Installation of permanent surface water control features; and
- Installation of surface monuments.

Custodial maintenance period

- Monitoring and surveillance; and
- Five-year reviews.

The final remedy for Maxey Flats leaves wastes at the site above health-based levels. This remedy was arrived at because exhumation and off-site disposal of the wastes, while physically possible to perform, would result in unacceptably high doses of radiation to site workers. Because wastes will be left in situ, the remedy will necessarily undergo an EPA-conducted review every five years following commencement of remedial action. Modifications to the remedy would occur through a Record of Decision amendment process if it were determined

during a five-year review, or at any point between, that the remedy was not providing overall protection of human health and the environment. Due to the extended time over which the remedy will be put in place, the **long-term effectiveness** of the remedy will be under constant evaluation. During the interim maintenance period, a maintenance staff would be required to perform frequent inspections and to make prompt repairs following subsidence. This 35 to 100 year period will provide an immense volume of data that can be used to assess the stability of the site, and thus accurately predict the performance of the final cap.

The remedy addresses indefinite custodial maintenance operations. This suite of **institutional controls** will last for at least 100 years following final closure and will include; fencing and other activities to control access to the site; periodic surveillance; filing of notices; survey plats and deed restrictions; and data collection and analysis to ensure success of the remedy.

Paducah Gaseous Diffusion Plant, Operable Unit 8

Site Name:	Paducah Gaseous Diffusion Plant
ROD:	EPA/ROD/R04-95/235
Site Ownership:	Federal
Site Focus Location:	Solid Waste Management Units (SWMUS) 2 and 3 of Waste Area Group 22 or OU 8
Contaminant of Concern:	Trichloroethene, arsenic, silver, manganese, vanadium, beryllium, uranium, and technetium-99
Remedy:	Construction of a low permeability, multilayered cap, implementation of a groundwater monitoring program, **institutional controls** will be set up, contaminated ground water will be extracted, extracted ground water will be collected and piped to a treatment system, and two treatability studies will be developed. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 4 – Kentucky
Site Size:	740 acres (300 hectares)
Waste Media:	Buried drums and uranium metal (solid and dissolved in aqueous solutions). ***See the summary of deposited wastes for greater detail.***

Overview

The United States Department of Energy is conducting environmental cleanup activities at the Paducah Gaseous Diffusion Plant (PGDP) under the DOE Environmental Management and Enrichment Facilities Program. These cleanup efforts are required to address contamination that has resulted from past waste handling and disposal practices at the plant. The DOE is conducting the remedial activities in compliance with the requirements of the Kentucky Department for Environmental Protection (KDEP) and the United States Environmental Protection Agency.

Description/History of Site

The PGDP, located in western Kentucky, is an active uranium enrichment facility owned by the DOE. Effective July 1, 1993, the DOE leased the plant production operations facilities to the United States Enrichment Corporation, which in turn contracted with Lockheed Martin Utility Services, Inc. to provide operations and maintenance services. Lockheed Martin Energy Systems, Inc. manages EMEF Program activities for the DOE.

Waste Area Group 22 consists of the following solid waste management units (SWMUs):

- SWMU 2, the C-749 Uranium Burial Ground;
- SWMU 3, the C-404 Low-Level Radioactive/Hazardous Waste Burial Ground.

These two units are situated within the security-fenced area in the northwest portion of the plant. SWMUs 2 and 3 are located near the west-central portion of the security-fenced area of the PGDP. Both burial grounds have been capped, SWMU 2 with a 6 in (15 cm) clay cap and 18 in (46 cm) vegetative cover and SWMU 3 (a regulated unit) with a (RCRA) multilayered clay cap. The surfaces of both burial grounds are primarily grass covered. Surface elevations vary from about 370 to 390 ft (113 to 119 m) above mean sea level in the immediate vicinity of the two units. Surface runoff from the SWMUs flows into the ditches located north, south, and east of the units and discharges through Kentucky Pollutant Discharge Elimination System Outfall 015 to Big Bayou Creek.

Summary of Local Physical Conditions

The PGDP is located in McCracken County in western Kentucky, approximately 3.5 miles (5.6 km) south of the Ohio River. The PGDP facility covers about 1,335 acres (540 ha), with approximately 740 acres (300 ha) situated within a fenced security area; the remaining 595 acres (240 ha) are maintained by the DOE as a **buffer zone** surrounding the plant. Approximately 2,100 acres (850 ha) of land beyond the **buffer zone** are leased by the DOE to the Commonwealth of Kentucky as part of the West Kentucky Wildlife Management Area (WKWMA). The WKWMA is used extensively for recreation, primarily hunting and fishing.

The subsurface at the PGDP consists of approximately 340 ft (104 m) of unconsolidated sediments overlying Mississippian limestone bedrock. The following discussion focuses on the lithologies present beneath SWMU 2.

Surface deposits in the vicinity of SWMU 2 consist of approximately 13 to 20 ft (4.0 to 6.1 m) of silt loam and silty clay loam. These deposits consist of about 6 ft (1.8 m) of soil and an underlying 7 to 14 ft (2.1 to 4.3 m) thick layer of wind deposited, fine grained, silty material called loess.

Underlying the surficial deposits are unconsolidated sediments consisting of interbedded and interlensing gravel, sand, silt, and clay soil types. These deposits, divided into the Upper and Lower Continental Deposits, were lain down in the region during the late Tertiary and Quaternary periods. The Upper Continental Deposits consist primarily of clayey silt, with thin layers of sand and occasional gravel found at a depth of about 13 to 20 ft (4.0 to 6.1 m). They are approximately 40 to 50 ft (12.2 to 15.2 m) thick in the vicinity of SWMW 2. The loess and the Upper Continental Deposits have been informally grouped into a groundwater flow system referred to as the Upper Continental Recharge System (UCRS). Water level measurements from UCRS Monitoring Well 154 located at the northern edge of SWMU 2 indicate an area of high groundwater elevations at SWMU 2. The groundwater flow direction within the UCRS is ultimately downward through the low permeability clay, silt, or clayey silt layer separating the Upper and Lower Continental Deposits.

The top of the Lower Continental Deposits is typically found at depths of approximately 60 to 70 ft (18.3 to 21.3 m). The Lower Continental Deposits consist predominantly of well-rounded chert gravel with sand and are approximately 20 to 30 ft (6.1 to 9.1 m) thick in the vicinity of SWMU 2.

The Continental Deposits are underlain by the McNairy Formation at depths of approximately 85 to 100 ft (25.9 to 30.5 m). The McNairy Formation in this area of the plant site has been described as brown to gray, silty, clayey, very fine sand with dark gray silty clay. The total thickness of the McNairy Formation is approximately 225 ft (68.6 m. Directly underlying the McNairy Formation are the Mississippian rubble zone and the Cretaceous Tuscaloosa Formation, which consist of a 5 to 20 ft (1.5 to 6.1 m) thick layer of subangular chert and silicified limestone fragments. Deep borings at the PGDP have encountered Mississippian limestone bedrock at depths of approximately 335 to 350 ft (102 to 107 m).

The principal pathway of groundwater flow at the PGDP is the regional gravel aquifer (RGA), which consists of unconsolidated gravel and sand deposits occurring between 40 and 100 ft (12 and 33 m) below land surface (bls). From the PGDP, groundwater within the RGA flows in a northward direction toward the Ohio River, which is the local base level for the system. Groundwater contaminant plumes originating from the PGDP and extending north and northeast from the plant are located within this aquifer.

Summary of Deposited Wastes

The Uranium Burial Ground

The C-749 Uranium Burial Ground (SWMU 2) is located in the west-central portion of the plant and on the western edge of the C-404 Low-Level Radioactive/Hazardous Waste Burial Ground. It encompasses an area of approximately 734 acres (297 ha) with approximate dimensions of 160 by 200 ft (49 by 61 m) and is divided into 0.46 acre (0.19 ha) sections. The C-749 Uranium Burial Ground was used for the disposal of uranium and uranium containing wastes. The exact depth of the buried waste is not known. Wastes were reportedly placed in trenches excavated to a total depth of approximately 7 to 17 ft (2.1 to 5.2 m) and then covered with 2 to 4 ft (0.61 to 1.2 m) of soil. In 1982, the C- 749 Uranium Burial Ground was covered with a 6 in (15 cm) clay layer and an 18 in (46 cm) vegetative cover. It has been estimated that 270 tons (274.3 metric tons) of uranium, 159,000 gallons (601,815 liters) of oil, and 450 gallons (1,703 liters) of trichloroethene (TCE) were buried in SWMU 2. Most of the waste consisted of pyrophoric uranium metal in the form of machine shop turnings, shavings, and sawdust. Pyrophoric uranium metal was usually placed in 55 gallon (208 liters) drums and petroleum-based or synthetic oils were used to stabilize the waste. It is possible these oils may have included some PCB-contaminated oils. Other forms of uranium, including oxides of uranium (solid and dissolved in aqueous solutions), uranyl fluoride solutions, uranium-zirconium alloy, slag, and uranium tetrafluoride were buried in smaller quantities.

There is no documentation of technetium-99 (99-Tc) disposal at SWMU 2, but its presence is suspected due to its association with operations at the PGDP. Technetium was produced at the PGDP as a by-product of reprocessing reactor tailings. A portion of the uranium-containing wastes disposed in burial grounds at the PGDP likely contains 99-Tc from this source. In

addition, the detection of 99-Tc in groundwater samples from nearby monitoring wells indicates that it may be present in SWMU 2.

The Low-Level Radioactive/Hazardous Waste Burial Ground

The C-404 Low-Level Radioactive/Hazardous Waste Burial Ground (SWMU 3) is located immediately east of the C-749 Burial Ground in the west-central area of the plant. It is approximately 140 by 380 ft (42.7 by 115.8 m) and was originally constructed in the early 1950's as an above ground holding pond, with an on-grade tamped earth floor and 6 ft (1.8 m) high clay dike walls. The burial ground was used from 1951 to 1957 as a primary disposal area for 99-Tc and uranium-contaminated effluent. In 1957, all free liquids were removed and disposal of uranium-contaminated bulk solid wastes began at the unit. In 1976, after the facility was filled with bulk solid waste, it was covered with compacted earth and the weir at the southwest corner was converted into a leachate collection sump. From 1977 until closure of the unit in 1986, the upper portion of SWMU 3 was used for the disposal of bulk and containerized uranium-contaminated solid waste. A portion of this waste, consisting of approximately 645 drums of precipitation filter cake (end products from the gold dissolver process) was found to be hazardous by the RCRA standards in 1986. Solid Waste Management Unit 3 was subsequently covered with a RCRA multilayered cap and certified closed in 1987. It is regulated under RCRA as a land disposal unit and is required to comply with a RCRA post-closure permit, which was issued in September 1992.

Discussion of Issues Leading to the ROD

The results of the Phase I and Phase II site investigations indicate that organic, metal, and radionuclide contamination is present in surface soils, subsurface soils, and ground water in the SWMU 2 area. The source of this contamination is low-level (radioactive) waste, primarily uranium and uranium-contaminated material, buried within the unit.

Over 30 chemicals of potential concern (COPCs) were identified in the Remedial Investigation addendum for Waste Area Grouping 22, Burial Grounds, Waste Management Units 2 and 3, at the Paducah gaseous diffusion plant risk assessment. Nineteen of these COPCs were determined to pose a risk great enough to be considered COPCs for the feasibility study for Solid Waste Management Units 2 and 3 of Waste Area Group 22 at the Paducah Gaseous diffusion Plant.

The principal organic contaminant detected in the ground water at SWMU 2 is TCE, found primarily in the UCRS at concentrations varying from about 4 to 1,400 micrograms per liter (µg/l). Trichloroethene also has been detected in the upper RGA, at levels ranging from <5 to 98 µg/l. Trichloroethene is transported as a dissolved phase liquid in the direction of ground water flow. It also has the potential to migrate in the form of a dense nonaqueous phase liquid (DNAPL). As the buried waste containers degrade within SWMU 2, DNAPLs could migrate to subsurface soils and groundwater.

Metals have been detected above Phase II site investigation reference levels in soil and ground water samples at SWMU 2. Arsenic and silver were detected in soil samples taken from borings located at the perimeter of SWMU 2. The principal inorganic contaminants in the groundwater at SWMU 2 are manganese, vanadium, and beryllium. Beryllium was detected in total (unfiltered)

metals analyses at levels above allowable drinking water maximum contaminant levels in the UCRS. Manganese and vanadium were detected at levels above reference values in UCRS wells located near SWMU 2.

Radiological contamination has been detected in shallow soil samples from borings located at the perimeter of SWMU 2, primarily at H 221 northwest of SWMU 2 and at H 262 southwest of SWMU 2. The radionuclides 99-Tc [up to 58 pCi/g] and total uranium (up to 89 pCi/g) have been detected in surface soils and in the ditch southwest of the unit to a depth of approximately 6 ft (1.8 m). The extent of surface radiological contamination likely extends from H 221 in the swale west of SWMU 2 and from H 262 in the ditch south of SWMU 2 to Outfall 015.

Two radiation walkover surveys of SWMU 2 were conducted in August 1994. The survey results indicate that a generalized, low-level gamma field exists across SWMU 2. The field may be partially attributable to the large quantities of uranium metal buried in SWMU 2. Cylinder storage yards located adjacent to SWMU 2 likely also contribute to the elevated gamma readings. In addition, during the Phase II site investigation, a radiation walkover survey of the ditch located south of SWMU 2 was conducted. The results of this survey indicate that beta and gamma emitters are present at the surface of the ditch at levels exceeding three times background.

Summary of Actions Proposed

Cost Estimates for this Interim Action

Direct Costs	$1,184,000	
Indirect Costs	$1,431,000	
Total Capital Costs [a]		**$2,615,000**
O&M Costs Year 1 [a]	$76,000	
O&M Costs Years 2-30	$1,350,000	
5 Year Review Costs	$54,000	
Total O&M Costs		**$1,480,000**
Total Contingency [b]		**$1,022,000**
Total Cost [c]		**$5,117,000**
Present Value [d]		**$3,761,000**

a. Capital costs for cap only; monitoring well and piezometer capital costs incorporated into first year O&M.
b. Total contingency is inclusive of direct, indirect, and all O&M cost-associated contingencies.
c. Cost estimates intended to be consistent with EPA guidance which recommends a +50 percent to -30 percent level of accuracy.
d. Present value estimate based on a 30-year time span with a 7 percent discount rate.

The modifications presented in the selected remedy will allow greater flexibility, allow expedited field investigation activities, and promote an incremental approach to implementation of the interim remedial action. The DOE will prepare a detailed design for this interim remedial action in accordance with the requirements specified in the declaration of this ROD. The remedial design and remedial action phase activities for the interim action will be finalized following completion of additional investigative activities planned for SWMU 2.

The selected remedial action will consist of the following elements, at a minimum:

- A low permeability, multilayered cap constructed over the areal limits of SWMU 2. The cap will be designed to direct rainfall away from the unit and inhibit infiltration of precipitation into the unit. The cap will also serve as a physical barrier to inhibit direct contact with buried waste materials and soil contamination. The conceptual capping option may consist of compacted soil as contour material, a geosynthetic clay liner, a geomembrane liner, and a drainage layer with a vegetative soil cover;
- A ground water monitoring program implemented in the uppermost aquifer, the RGA, to detect the potential release of contaminants from SWMU 2. The monitoring program will also evaluate the cap's effect on the shallow ground water level in the UCRS and fill data gaps. Any waste soil generated during sampling and remedial action activities will be managed within the limits of SWMU 2 and placed on the unit as contour material for the cap. All other wastes such as personal protective equipment will initially containerized and managed at the PGDP in accordance with approved protocols;
- **Institutional controls** implemented to further prevent access to SWMU 2. Deed restrictions may be utilized to ensure that DOE retains ownership of the property, which SWMU 2 encompasses. Deed restrictions also may prevent future uses of the property, which could result in the spread of contamination, such as installing wells or excavating. Since contaminants will remain in the unit following this interim remedial action, the DOE will conduct administrative reviews of the action and monitoring data no less than once every five years, at least until a final remedial action has been selected or implemented for SWMU 2;
- This action will provide overall protection of human health and the environment. It also can be implemented in compliance with ARARs. This interim action will provide effectiveness until a final remedy is enacted at SWMU 2. Although treatment will not be employed, contaminant mobility will be reduced as a result of reduced infiltration. This alternative will provide short-term effectiveness and may be readily implemented. The total estimated cost for this alternative and cap option is $5.1 million (present value of $3.7 million);
- The contaminated groundwater will be extracted at a location in the northern portion of the high TCE concentration area of the plume (greater than 1,000 micrograms per liter of TCE). The contaminated groundwater will be pumped at a rate of approximately 100 gallons per minute to initiate hydraulic control without changing groundwater gradients enough to cause adverse effects. During operation this pumping rate may be modified to optimize hydraulic containment by adjusting flow from the extraction wells and to support subsequent actions;
- The extracted ground water will be collected and piped to a treatment system prior to release to a Kentucky Pollutant Discharge Elimination System permitted outfall. The

treatment facility will consist of a sand filter for removal of suspended solid materials, and utilization of the PGDP's existing cooling towers for volatilization of contaminated ground water. The chemicals of concern are TCE and 1,1-dichloroethene; and

- Two treatability studies, which include: (1) photocatalytic oxidation of TCE-contaminated off-gas; and (2) in situ treatment of TCE-contaminated ground water.

Feed Materials Production Center (FERNALD), Overview

In May 1951, the Atomic Energy Commission, predecessor to the DOE, initiated construction operations at the Feed Materials Production Center. Full-scale production was initiated after pilot operations began in 1952 and continued until July 1989. Production peaked in 1960 at approximately 13,288 tons (13,500 metric tons) of uranium a year. A decline in product demand began in 1964 and reached a low in 1975. In the early 1980's, production increased significantly, resulting in a major facilities restoration program. Production ceased in the summer of 1989 and plant resources were directed toward environmental remediation activities. The facility was formally closed by congressional authorization in June 1991. To identify the environmental nature of the site's new mission, the name of the facility was changed to the Fernald Environmental Management Project (FEMP).

When production operations were halted in 1989, due to a declining defense demand for uranium, available resources were redirected to focus on environmental restoration of the facility. Past releases and continued releases resulting from the accumulation of a large inventory of uranium process materials and mixed wastes at the FEMP prompted concern about the potential impact on human health and the environment.

In November 1989, the EPA placed the FEMP on the National Priorities List. Inclusion on the NPL reflects the relative importance placed by the federal government on ensuring the expedient completion of the remedial investigations and resulting in cleanup actions. Five Operable Units were identified for response actions.

The Department of Energy's Feed Materials Production Center (now more commonly referred to as the Fernald Environmental Management Project site) was the site of uranium processing operations until its closure in 1989. The loss of its national security mission, however, was quickly replaced with an intensive environmental management mission. The entire FEMP site encompasses 1,050 acres (425 ha) in southwestern Ohio, and is located roughly 18 miles (29 km) northwest of Cincinnati. The actual uranium processing operations at FEMP were confined to a fenced 136 acre (55 ha) tract known as the production area. The remaining FEMP site consists of "forest and pasture lands, a portion of which is leased for grazing livestock."[1]

[1] Unless otherwise noted, all material contained within quotation marks in these FEMP ROD summaries is drawn from EPA documents PB95-964111 and PB95-961114, which contain the full text of the Record of Decision related to Operable Unit 1 and Operable Unit 2 at the former Feed Materials Production Center in Fernald, Ohio.

There are six Operable Units defined at the FEMP site. These are:

Operable Unit 1 – waste pit area
Operable Unit 2 – other waste units
Operable Unit 3 – former production area
Operable Unit 4 – silos 1 through 4
Operable Unit 5 – environmental media
Operable Unit 6 – comprehensive site-wide (if needed)

The Great Miami aquifer is the principal aquifer within the FEMP study area and has been designated a **sole-source aquifer** by the U.S. Environmental Protection Agency, under provisions of the Safe Drinking Water Act.

The following are summaries of the Records of Decision entered for Operable Units 1 and 2.

Summary of Local Physical Conditions

Operable Units 1and 2 are located within the fence line that isolates the former production area from the rest of the FEMP site. Although the FEMP site slopes primarily west to east toward the Great Miami River, OUs 1 and 2 slope east to west towards a smaller tributary of the river known as Paddys Run.

The FEMP site overlies a geologic formation that is composed of a largely clay-dominated till glacial overburden that overlays glacial outwash material. The glacial outwash materials are part of the Great Miami Aquifer (designated a sole-source aquifer by the EPA under provisions of the Safe Drinking Water Act). Natural erosion has removed much of the glacial overburden such that many streams (including Paddy Run) are now in direct contact with the Great Miami Aquifer. Where this glacial overburden is evident at the surface, it displays a relatively low permeability. Perched groundwater is found in heterogeneous and asymmetric pockets of silty sand and gravel beneath the FEMP site. Depth to the perched groundwater ranges from 1 to 15 ft (0.3 to 4.6 m), with seasonal variations of up to 10 ft (3 m).

Feed Materials Production Center, Operable Unit 1

Site Name:	Feed Materials Production Center, Operable Unit 1
ROD:	EPA/ROD/R05-95/286
Site Ownership:	Federal
Site Type:	Solid and sludge waste repositories
Contaminants of Concern:	**Radionuclides, TRU:** Np-237, Pu-238, Pu-239/240
Remedy:	**FINAL.** Construction of waste processing and loading facilities and equipment; removal of water from open waste pits for treatment and from the site's wastewater treatment facility; removal of waste pit contents, caps and liners, and excavation of surrounding contaminated soil.
EPA Region:	Region 5 - Ohio
Site Size:	37.7 acres (15.25 ha)
Waste Media:	Solid & liquid waste pits

Description/History of Site

Operable Unit 1 is a well-defined 37.7 acre area located in the northwest quadrant of the FEMP site. In execution of its national security mission, large quantities of liquid and solid wastes were generated by various chemical and metallurgical processing operations at the Feed Materials Production Center. These wastes were stored, burned, or disposed of in six waste pits, the clearwell, and the burn pit. These pits are located in a portion of the FEMP waste storage area and are contained within the boundaries of Operable Unit 1.

Beginning in 1952, the waste pits were constructed to store slurried or dry residuals resulting from various stages of uranium processing. Historically, the wastes generated at the FEMP facility, as well as some wastes shipped from other DOE facilities, were disposed on the property. Descriptions of the six waste pits, clearwell, and burn pit are provided below.

Waste Pit 1

Estimated Waste Volume:	48,500 yd^3 (37,083 m^3)
Estimated Total Volume:	68,400 yd^3 (52,298 m^3)
Approximate depth:	29.5 ft (9 m)
Surface area:	2.11 acres (0.85 ha)
Liner type:	Natural clay

Waste Pit 1 was constructed in 1952 and is considered a dry pit, as the emplaced waste slurries (with the exception of effluent from the general sump) were filtered or calcined to remove water before they were placed in the pit. Waste Pit 1 was closed and covered with clean fill in 1959 and is currently classified as a RCRA SWMU.

Waste Pit 2

Estimated Waste Volume:	24,200 yd^3 (18,503 m^3)
Estimated Total Volume:	37,400 yd^3 (28,503 m^3)
Approximate depth:	23.5 ft (7.16 m)
Surface area:	0.90 acres (0.56 ha)
Liner type:	Natural clay

Waste Pit 2, constructed in 1957, is also considered a dry pit. Waste Pit 2 was closed and covered with clean fill in 1964 and is currently classified as a RCRA SWMU.

Waste Pit 3

Estimated Waste Volume:	204,100 yd^3/156,046 m^3
Estimated Total Volume:	307,500 yd^3/235,101 m^3
Approximate depth:	42 ft (12.8 m)
Surface area:	5.00 acres (2 ha)
Liner type:	Natural clay

Waste Pit 3 was placed in service in 1958 and was the first waste pit built specifically for settling solids from liquid waste streams. In 1977, Waste Pit 3 was covered with soil; it is currently classified as a RCRA SWMU.

Waste Pit 4

Estimated Waste Volume:	55,100 yd^3 (42,119 m^3)
Estimated Total Volume:	72,800 yd^3 (55,663 m^3)
Approximate depth:	32 ft (9.75 m)
Surface area:	1.50 acres (0.6 ha)
Liner type:	Natural clay

Waste Pit 4 was constructed in 1960. Disposal activities at Waste Pit 4 were terminated in 1985. Waste Pit 4 is currently classified as a RCRA HWMU and has undergone interim closure. Waste Pit 4 was classified as a HWMU in 1984 because, at that time, it was believed the pit contained characteristic barium waste, because Waste Pit 4 was used to dispose of barium chloride salts from 1981 to 1983. Waste Pit 4 was closed in 1986 and activities were started to cover the pit. During interim closure, the pit was covered with fill material, clay, and a polyethylene liner. Final closure documentation of Waste Pit 4 will be completed in conjunction with remedial actions under CERCLA.

Waste Pit 5

Estimated Waste Volume:	97,900 yd^3 (74,854 m^3)
Estimated Total Volume:	97,900 yd^3 (74,854 m^3)
Approximate depth:	29 ft (8.8 m)
Surface area:	3.74 acres (1.5 ha)
Liner type:	EPDM

Waste Pit 5 was constructed and placed into service in 1968. The discharge of slurried waste materials to Waste Pit 5 was stopped in 1983 and use of this waste pit as a settling basin was

discontinued in 1987. Waste Pit 5 is currently covered by water and is classified as a RCRA HWMU.

Waste Pit 6

Estimated Waste Volume:	9,600 yd^3 (7,340 m^3)
Estimated Total Volume:	9,600 yd^3 (7,340 m^3)
Approximate depth:	20 ft (6.1 m)
Surface area:	0.74 acres (0.3 ha)
Liner type:	EPDM

Waste Pit 6 was made operational in 1979. Use of Waste Pit 6 ceased in 1985; it is currently covered by water and classified as a RCRA SWMU.

Burn Pit

Estimated Waste Volume:	30,300 yd^3 (23,167 m^3)
Estimated Total Volume:	30,300 yd^3 (23,167 m^3)
Approximate depth:	26 ft (7.9 m)
Surface area:	0.50 acres (0.2 ha)
Liner type:	None

The Burn Pit dates to the late 1950's. The Burn Pit was filled in 1968 during the construction of Waste Pit 5; it is currently classified as a RCRA SWMU.

Clearwell

Estimated Waste Volume:	3,700 yd^3 (2,829 m^3)
Estimated Total Volume:	4,300 yd^3 (3,288 m^3)
Approximate depth:	12 ft (3.7 m)
Surface area:	0.65 acres (0.26)
Liner type:	Natural clay

The Clearwell was constructed in 1959 and received surface water runoff from the waste pits and surface liquid (supernatant) from Waste Pits 3 and 5. It acted as a final settling basin prior to periodic discharge to the Great Miami River. The Clearwell is currently classified as a RCRA SWMU.

Summary of Deposited Wastes

The majority of the hazardous constituents identified during characterization of Operable Unit 1 were introduced to the plant during the refining of feed materials. A summary of the types of wastes deposited in OU1 pits and the Clearwell follows. A more detailed table illustrating the detected concentrations of radionuclide, inorganic, and organic constituents found within OU 1 can be seen in Appendix C.

Waste Pit 1

This waste pit received primarily depleted magnesium fluoride slag and depleted residues with smaller amounts of trailer cake, uranyl ammonium phospate (UAP) filtrate, graphite/ceramics,

and general sump sludge. It was, however, used as a clearwell for liquids removed from Waste Pit 2 in 1958 and 1959.

Waste Pit 2
Waste Pit 2 received primarily trailer cake and general sump sludge with smaller amounts of UAP filtrate, raffinate, depleted residues and, graphite/ceramics. It was also used as a settling basin for neutralized raffinate prior to completion of Waste Pit 3.

Waste Pit 3
Lime-neutralized raffinate slurries, as well as contaminated storm water from the Burn Pit, were pumped to Waste Pit 3. After Waste Pit 2 was filled, Waste Pit 3 received general sump sludge, raffinate, trailer cake, and slag leach with lesser amounts of water treatment sludge and thorium wastes. Starting in 1958, lime sludge from the water treatment plant was added to supplement the lime used for raffinate neutralization. Also, large quanitities of neutralized residues from acid leaching of uranium-bearing magnesium fluoride slag were pumped to Waste Pit 3 during the late 1960s. In 1973, fill material, including filter cake, slag leach residue, lime sludge, and flyash was placed in Waste Pit 3.

Waste Pit 4
Waste Pit 4 received solid wastes that included trailer cake, depleted slag, and depleted residues, with lesser amounts of thorium wastes and graphite/ceramics. The process residues included filter sludges, raffinates, graphite, magnesium fluoride slag, and pyrophoric uranium-bearing materials. At least 100 thorium metal and residue-containing drums were placed in Waste Pit 4 in drums. Barium chloride-contaminated floor sweepings were disposed of in Waste Pit 4 from 1980 to 1983.

Waste Pit 5
Waste Pit 5 served as a settling basin for slurries in the form of general sump sludge, raffinate, slag leach, water treatment sludge, and thorium waste. The supernatant and sludges produced by the co-precipitation of thorium wastes with barium carbonate and aluminum sulfate, and by the precipitation of uranium with calcium oxide, were deposited in Waste Pit 5.

Waste Pit 6
Waste Pit 6 received depleted wastes in the form of depleted slag and depleted residue. Extrusion residue and heat treatment quench water were also deposited in Waste Pit 6.

Burn Pit
The Burn Pit was used to burn materials such as laboratory chemicals, phyrophoric and reactive chemicals, oils, low-level contaminated materials such as pallets and skids, and cafeteria debris.

Clearwell
The Clearwell received surface water runoff from the waste pits and surface liquid (supernatant) from Waste Pits 3 and 5.

Discussion of Issues Leading to the ROD

The reasoning behind remediation of Operable Unit 1 is displayed in the Record of Decision itself: "Actual or threatened releases of hazardous substances from Operable Unit 1, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment." The ROD continues, "The primary focus of remedial action for Operable Unit 1 is the permanent disposition of contaminated contents of the six Waste Pits, the Clearwell, and the Burn Pit. The purpose of the remedial action is to prevent unacceptable current or future exposure to the contaminated materials of Operable Unit 1 and to mitigate the release of hazardous substances into the environment. The selected remedy addresses the principal threats associated with the contaminated materials in Operable Unit 1."

Environmental monitoring and sampling of the waste pits, soil, surface and groundwater, sediment, and air associated with OU 1 occurred on several occasions beginning in 1984. These investigations include the Characterization Investigation Study from 1986 to 1988, the Remedial Investigation/Feasibility Study in 1991 and 1992, the ongoing FEMP Environmental Monitoring Program, the site's RCRA Groundwater Study that began in 1985, and other special site programs undertaken to characterize the physical, chemical, and radiological properties of the site.

Summary of Actions Proposed

Capital Cost:	$513.05 million
Present Worth:	$389.5 million
Months of Operation:	60
O&M:	$63,722 per year (included in the present worth value)

The final remedy for Operable Unit 1 includes:

- Construction of waste processing and loading facilities and equipment;
- Removal of water from open waste pits for treatment at the site's wastewater treatment facility;
- Removal of waste pit contents, caps and liners, and excavation of surrounding contaminated soil;
- Confirmation sampling of waste pit excavations to verify achievement of remediation levels;
- Pretreatment (sorting/crushing/shredding) of waste;
- Treatment of the waste by thermal drying as required to meet the waste acceptance criteria of the disposal facility;
- Waste sampling and analysis prior to shipment to ensure that the waste acceptance criteria of the disposal facility are met;
- Off-site shipment of waste for disposal at a permitted commercial waste disposal facility. It is estimated that more than 600,000 yd^3 (458,760 m^3) of waste material will be excavated and disposed of as low-level radioactive waste;
- As a contingency, shipment for disposal at the Nevada Test Site of any waste that fails (due to radiological concentrations) to meet the waste acceptance criteria of the permitted commercial waste disposal facility (up to 10 percent of the total waste volume);

- Decommissioning and removal of the drying treatment unit and associated facilities, as well as miscellaneous structures and facilities within Operable Unit 1. Oversized material may be forwarded to Operable Unit 3 to be managed as construction rubble;
- Disposition of remaining OU 1 residual contaminated soils; and
- Placement of backfill into excavations and construction of cover system.

It is envisioned that the former production area (wherein OU 1 is sited) will remain a Federal reserve, and that the entire FEMP site will be **subject to institutional controls** (to include land and deed restrictions). Physical barriers (to include fences and warning signs) are currently surrounding OU 1. These will remain in place to deter human intrusion into the site.

The removal of wastes to a permitted commercial facility (or the NTS, should the need arise) will ensure the long-term effectiveness of the remedy. As stated in the OU 1 ROD, "Excavating the waste pit contents, treating them by thermal drying, and disposing of the waste at a permitted commercial disposal facility will provide a permanent solution to the threats posed by the subject contaminated materials." Removal of wastes to a permitted disposal facility will eliminate the likelihood of a release to the sole-source Great Miami Aquifer below the FEMP site. The ROD continues, "The health-based cleanup levels established in this Record of Decision are protective of human health and the environment assuming continued Federal ownership of the site."

Feed Materials Production Center, Operable Unit 2

Site Name:	Feed Materials Production Center
ROD:	EPA/ROD/R05-95/289
Site Ownership:	Federal
Site Focus Location:	Operable Unit 2
Contaminant of Concern:	Uranium-238, uranium-234, thorium-230, technetium-99,strontium-90, neptunium-237, metals, inorganics, and organics
Remedy:	Excavation of all material with contaminants of concern above the established cleanup levels, material processing for size reduction and moisture control if required, on-site disposal in an engineered disposal facility with a composite cap and liner system, and off-site disposal of a small fraction of the excavated material that exceeds the waste acceptance criteria of the on-site disposal facility. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 5 - Ohio
Site Size:	136 acres (55 ha)
Waste Media:	Solid, liquid and sludge (317,8000 yd^3) 242,990 m^3

Description/History of Site

The operational histories of the Line Sludge Ponds and Active Flyash Pile are well understood, but the operational histories of the Solid Waste Landfill, Inactive Flyash Pile, and South Field are vague and not well documented. Operable Unit 2 contains the following features:

- Solid Waste Landfill – reportedly used for the disposal of cafeteria waste, rubbish, and other types of waste from the nonprocess areas and on-site construction and demolition activities;
- North and South Lime Sludge Ponds – contain waste from the FEMP water treatment plant operations, coal pile storm water runoff, and boiler plant blowdown. The South Lime Sludge Pond is inactive and overgrown with grasses and shrubs, while the North Lime Sludge Pond is currently in use;
- Inactive Flyash Pile – used for the disposal of ash from the boiler plant and other nonprocess wastes and building rubble such as concrete, gravel, asphalt, masonry, and steel rebar;
- South Field – reportedly used as a burial site for FEMP nonprocess wastes such as flyash, on-site construction and demolition rubble, and soils that may have contained low levels of radioactivity;
- Active Flyash Pile – was the disposal area for flyash and bottom ash from the FEMP boiler plant; and
- Berms, liners, and soil within the OU boundary.

The primary focus of remedial action for OU 2 is the permanent disposition of the contaminated materials, including waste and soil, from each of the five subunits. The purpose of the remedial action is to prevent unacceptable current or future exposure to the contaminated materials of OU 2 and to mitigate the threat of continued release of hazardous substances into the environment.

Summary of Deposited Wastes

The nature and extent of radiological and chemical constituents within OU 2 are based on data collected during Phase I and Phase II of the remedial investigation (RI) field investigation activities. Data generated prior to RI field activities were used to define data objectives for the RI and for supplementary data. Transuranic isotopes and actinides were found only in the Solid Waste Landfill, the South Field, and in the Active Flyash Pile. For that reason, this summary will focus on those three components of OU 2.

Solid Waste Landfill
Trenching and boring activities in the Solid Waste Landfill have determined that cafeteria, laboratory, construction and maintenance, and manufacturing wastes were disposed of in the landfill. The depth of waste is generally 10 ft (3 m), with a maximum depth of 15 ft (4.6 m). Twenty-three contaminants of concern (COCs) have been identified for the Solid Waste Landfill, including 13 radionuclides (of interest are Np-237 at 3.11 pCi/g and Pu-238 at 0.9024 pCi/g), 4 metals, and 6 organic compounds. The extent of these COCs in the Solid Waste Landfill is distributed throughout the surface and subsurface fill materials. COCs were also detected in the glacial till beneath the landfill. The number of COCs detected in the surface water, sediment, and perched groundwater are fewer than those detected in the surface and subsurface soils.

South Field
Field investigations indicate that dumping of different types of material took place in the South Field, making the area heterogeneous. Test trenches uncovered a range of waste materials including concrete, steel pipe, sheet steel, wood, and clay tile. The results of wipe samples taken from these materials indicate that they represent a potential source for the leaching of radionuclides to groundwater.

Twenty-six COCs have been identified for the South Field. These COCs consist of 13 radionuclides (of interest is Np-237 at 0.483 pCi/g), 4 metals, and 9 organic compounds. The COCs in the South Field cover most of the surface and subsurface soils, surface water, sediment, perched groundwater, and groundwater sampled within the subunit. Radionuclides and organics were detected in higher concentrations in the northern portion of the South Field. The COCs were also detected in the perched groundwater beneath the subunit and in the Great Miami Aquifer downgradient of the subunit.

Active Flyash Pile
It has been determined from field observations and historical documentation that the Active Flyash Pile contains only flyash. Interviews with former processing personnel indicated that organic compounds could have been sprayed on the flyash to reduce fugitive emissions of particulates.

Fourteen COCs have been identified for the Active Flyash Pile – 11 radionuclides (of interest is Np-237 at 0.3 pCi/g) and three metals. The extent of COCs in the Active Flyash Pile covers most of the surface soils, subsurface soils, and sediment within the subunit.

Discussion of Issues Leading to the ROD

OU 2 conducted two phases of a CERCLA remedial investigation. Field investigation activities conducted from 1988 through 1992 are referred to collectively as the Phase I field investigation. Additional field investigations carried out in 1993 are called the Phase II field investigation. Each phase encompassed all affected media (surface water, sediment, surface soil, subsurface soil, and groundwater) and collected samples from all five subunits in OU 2.

In addition to the field investigations conducted under CERCLA, a removal site evaluation (RSE) and several removal actions were conducted in the OU 2 areas. A RSE was performed to assess lead contamination in the South Field firing range. The inactive Flyash Pile and South Field disposal area control removal action (Removal Action No. 8) consisted of the installation of ropes, fences, and warning signs around the perimeter of these waste areas to control access. Phase I of the activities included fencing and roping the areas to be controlled, and Phase II included a radiological survey of the area.

The Active Flyash Pile control removal action (Removal Action No. 10) was completed as a time-critical removal action to mitigate the wind and water erosion of the Active Flyash Pile. This was accomplished by re-grading the pile, installing a silt trap and wind barrier, and applying a crusting agent to the surface of the pile. Periodic routine inspections of the Active Flyash Pile and necessary maintenance of the erosion control measures are ongoing.

The Paddys Run erosion control removal action (Removal Action No. 29) was implemented in Paddys Run to provide bank stabilization adjacent to the Inactive Flyash Pile. Continued erosion of the bank could have undermined the slope of the pile and resulted in discharge of contamination to Paddys Run. Periodic routine inspections of the riprap stone and necessary maintenance of the erosion control measures are ongoing.

The South Field and Inactive Flyash Pile seepage control removal action (Removal Action No. 30) is a time-critical removal action that will collect contaminated surface water that is currently seeping into drainage ditches and migrating directly to Paddys Run or to the Great Miami Aquifer.

Summary of Actions Proposed

Present Worth:	$85.9 million (construction)
O&M:	$20 million (after remediation)
Months of Operation:	51 months (not including **long-term monitoring** and **institutional controls**)
	360 months (including monitoring and maintenance following remediation)

The remedy selected for OU 2 will provide protection of human health and the environment by removing contaminated material to satisfactory cleanup levels. This protection will be maintained through disposal of the removed material in an engineered, on-site disposal facility. The facility will utilize engineering design to preclude human and ecological contact with the contaminated material. The facility will also be designed so that it will not pose unacceptable impacts to the Great Miami Aquifer.

The remedy selected for OU 2 includes excavation of all soils with COCs above the cleanup levels, material processing for size reduction and moisture control if required, on-site disposal in an engineered disposal facility, and off-site disposal of a small fraction of the excavated material that exceeds the maximum waste acceptance criteria of the on-site disposal facility. The maximum waste acceptance criteria is 346 pCi/g of U-238, or 1,030 ppm of total uranium.

Debris (e.g., concrete, drums, steel, pallets,) from all subunits will be visually segregated, moved to the staging/material preparation area, processed for size reduction if required, and place in the on-site disposal facility. The remaining contaminated materials from the subunits would be excavated, as described below, and placed in the on-site disposal facility. It is estimated that 314,700 yd^3 (240,620 m^3) of OU 2 material will meet the waste acceptance criteria and be disposed in the on-site disposal facility. DOE will not dispose of any off-site waste in this facility.

It is estimated that up to 3,100 yd^3 (2,370 m^3) of material will not meet the waste acceptance criteria for on-site disposal. This is approximately one percent of the total waste material that will be excavated. This material will be packaged in containers suitable for shipment by rail or truck and transported to an off-site disposal facility. An off-site disposal facility has not yet been chosen; however, Envirocare in Clive, Utah, was used as a representative off-site disposal facility for purposes of the cost estimate.

Excavation will be completed to the required depth established by computer modeling to remove materials with COC concentrations above the cleanup levels. Upon reaching this predetermined depth, verification sampling and testing will be completed to confirm that all material with COC concentrations above their respective cleanup level has been removed. If the results of the verification sampling/testing indicate that contamination above the cleanup level remains, then additional excavation and verification sampling will be performed until acceptable test results are obtained.

The remaining soil will either be graded to blend in with the surrounding topography, or utilized for on-going construction activities at the FEMP. The excavation/disposal operation for the OU 2 subunits will be coordinated with the remedial operations associated with OU 3 and OU 5. Long-term monitoring will be performed at each subunit to monitor groundwater and surface water to ensure that any material with concentrations below an acceptable cleanup level that is left in place causes no adverse effects.

The **long-term effectiveness** of this remedy will be brought about through Federal ownership of the FEMP with access restrictions (fencing) and groundwater monitoring as **institutional**

controls at the subunits and on-site disposal facility. Cap maintenance will also be performed at the on-site disposal facility. Approximately 35 acres (14.2 ha) of the FEMP site, including a 300 ft (91 m) **buffer zone**, will be restricted for future use under this remedy. As this remedy will result in contaminants remaining on site in an engineered disposal facility, a review will be conducted no less often than every five years after the initiation of remedial action to ensure that the remedy continues to provide adequate protection to human health and the environment.

Melton Valley Watershed, Operable Unit 1

Site Name:	Melton Valley Watershed
ROD:	DOE/OR/01-1826&D3
Site Ownership:	Federal
Site Focus Location:	Operable Unit 1
Contaminants of Concern:	^{137}Cs, ^{60}Co, $^{239/240}Pu$, ^{241}Am, ^{244}Cm, ^{90}Sr, ^{3}H, As, Ba, Be, Cd, Cu, Tl, Zn, PCB-1260, Hg, Ni, Cr, Mo, and Se
Interim Remedy:	This interim remedy substantially controls and reduces site risks to an acceptable level through treatment, engineering and containment. ***See summary of a summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 4 - Tennessee
Site Size:	1,062 acres (430 ha)
Waste Media:	Solid and solidified-liquids, containerized and loose, containing radionuclides, organics, and inorganics

Overview

The 1,062 acre (430 ha) Melton Valley Watershed was a plutonium production site during World War II and a nuclear technology development site after the war. It is located within and adjacent to the corporate city limits of Oak Ridge, Tennessee, and also in Roane and Anderson counties, which are approximately 12.5 miles (20.1 km) west-northwest of Knoxville. The area is bounded on three sides by the Clinch River and in the north by the city of Oak Ridge. Three major World War II-era industrial research and production facilities were constructed as part of the Manhattan Project. From 1943 to 1986, the area was a major disposal site for wastes from over 50 off-site government-sponsored isotope users and buried in unlined trenches. Since 1988 silos, wells, trenches and aboveground tumuli have been used for disposal. The above-grade disposal was conducted in two areas of the site. These areas are in interim closer status awaiting a final cap. Since 1992 the Interim Waste Management Facility has operated and approximately 1,962 yd^3 (1,500 m^3) of capacity remains. Present and potential threats to human health and the environment are posed by disposed waste and contaminated media in the watershed.

Description/History of Site

From 1943 to 1986 shallow land burial was routine. Early burial procedures used unlined trenches and auger holes covered by either soil from the trench or a combination of concrete caps and soil. In 1986 the solid waste was placed in below-grade concrete-lined silos. Waste Area Grouping (WAG) 13 and WAG 11 were removed and disposed of in silos or underground vaults in SWSA 6.

Radiological and hazardous chemical contamination of soil and sediment occurs in many areas of the Melton Valley watershed. Liquid low-level radioactive waste (LLLW) was stored in a

variety of tanks with little to no protection against corrosion or secondary containment of leaks. Several impoundments of natural clays with no liner stored wastewater. From 1951 to 1966 chemically treated LLLW was disposed of in large seepage pits and trenches excavated in low-permeability clay soil acting as a sorption agent. Two hydrofracture well injection sites were used for waste disposal process and two were experimental. Dozens of wells, ranging in depth from ~600 to ~1,000 ft (183 to 305m) deep monitored performance of the hydrofracture process. Unless properly plugged and abandoned, these wells are potential pathways for contaminated fluids to migrate from deep groundwater to shallower groundwater zones. The LLLW system includes a complex series of buried waste pipelines used to transport radioactive liquid waste. The environmental media surrounding some surface structures have been impacted by contaminant release.

Summary of Local Physical Conditions

Melton Valley is currently a restricted area under DOE control. Most of the valley consists of waste burial grounds. A large part of the land surrounding the valley has been contaminated as a result of past DOE activities. One of three reactors in the eastern part of the valley, HFIR, is operational.

Since the area is restricted in access, the surface water and environment are not used (for example, no recreation use or livestock watering). White Oak Creek and Melton Branch are currently classified by the state of Tennessee for Fish and Aquatic Life, Recreation, and Livestock Watering and Wildlife uses, and as such must meet the standards suitable for those uses. All other surface water flowing out of the watershed is classified for irrigation.

Remedial action is expected to result in industrial use with limited restrictions in the eastern portion of the Melton Valley watershed; the western portion of the valley will continue as a waste management area because the large quantities of radioactive and hazardous waste already there would be impractical to move or treat; the floodplain soil will be remediated to 2,500 μR/hr to meet the stream use classification standard. This will improve the groundwater, as well, though final groundwater remediation is not in this ROD.

Surface water is the principle exit pathway that carries contamination from the source areas to the Clinch River, though there is also significant contamination to the soil and in groundwater near the boundaries of the waste disposal areas. The shallow groundwater within the Melton Valley watershed discharges to surface water at seeps, tributaries, Melton Branch, and White Oak Creek. Most areas releasing significant quantities of contamination to surface water appear to be associated with perennially inundated shallow land burial trenches.

Summary of Deposited Wastes

Within the 1,062 acre (430 ha) Melton Valley watershed lie several disposal types of contaminated waste. These include:

Buried waste. Shallow land burial was used for disposal of solid LLW from 1943 to 1986 in SWSAs 4, 5, and 6. First burial procedures used unlined trenches and auger holes covered by

either soil from the trench excavation or a combination of concrete caps and soil. Beginning in 1986 in SWSA 6, solid LLW was placed in below-grade concrete-lined silos. WAG 11 and WAG 13 were disposed in silos or underground vaults in SWSA 6. From 1988 to 1990 above-ground tumuli technology was used for above-grade disposal at Tumulus I; Tumulus II operated from 1990 to 1992. The Interim Waste Management Facility has operated since 1992 and has approximately 1,962 yd^3 (1,500 m^3) of capacity remaining out of a full capacity of 656.2 yd^3 (5,400 m^3). KEMA fuel and high-activity waste in SWSA 6 will be removed in FY 2001. Twenty -three trenches in SWSA 5 North are retrievable storage for TRU waste and will be removed under authority of the Atomic Energy Act, in support of the National TRU Waste Program.

Landfills. Bulky solid waste that is not LLW was put in on-site landfills. Landfills in Melton Valley include SWSA 5 NW Landfill, SWSA 5 NE Landfill, SWSA 5 Dump Area, and the Contractors Spoil Area.

Tanks. Liquid low-level (radioactive) waste (LLLW) was concentrated and stored in underground storage tanks. Some tanks were abandoned and the waste and sludge left in them. All tanks are made of steel but some have no secondary containment to capture leaks. Five of the 12 tanks are being remediated in the FFA Tanks program which are incorporated in the Bethel Valley ROD.

Impoundments. Several ponds and basins were made of natural clays with no liner except the Process Waste Sludge Basin (PWSB) which had a polyvinylchloride liner. The PWSB and OHF pond are included for removal action in this ROD.

Seepage pits and trenches. Several seepage pits and trenches excavated in low-permeability soil were used from 1951 to 1966. As intended, chemically treated LLLWs seeped into the surrounding clay soil as a sorption agent for some radionuclides in the waste.

Hydrofracture wells and associated grout sheets. Melton Valley contains four hydrofracture well injection sites, though two were experimental. A waste/grout slurry was pumped into the hydraulically fractured bedrock 800-1,000 ft (244-305m) below ground and allowed to harden. 1.5 million currie of radioactive waste containing mostly fission products (^{137}Cs and ^{90}Sr) and some TRU waste sludge, hardened in the solid grout layers between the bedrock sheets in lines several hundred feet long. Dozens of wells were dug from 600 to 1,000 ft (183 to 305m) deep to monitor the flowing and hardening process. It is the wells that, unless properly plugged, are potential pathways for contaminated fluids to migrate from deep to shallow groundwater zones.

Buried liquid waste transfer pipeline. Buried pipelines constructed of a variety of materials transported radioactive liquid waste through the site.

Surface structures. In some cases environmental media (e.g., soil, groundwater, and surface water) surrounding the structures are contaminated.

Contaminated soil and sediment. Many areas of the Melton Valley watershed have radiological and hazardous chemical contamination from surface spills, pipeline leaks, and surface breakouts

from seepage pits, trenches, and water burial trenches. Contaminated biological material include leaves and animal droppings. Former Intermediate Holding Pond (IHP, east of SWSA 4) now contains the most highly contaminated floodplain soil.

Discussion of Issues Leading to the ROD

The Melton Valley watershed contains several waste disposal areas. Those areas contain large quantities of contaminated soil, injected waste, and buried waste. Significant contamination occurs in soil and groundwater near the boundaries of the waste disposal areas. The shallow groundwater within the Melton Valley watershed discharges to the surface at seeps, tributaries, Melton Branch, and White Oak Creek. These principal exit pathways carry contamination to the Clinch River. Both humans and the local ecology are at risk in the watershed.

For humans, the use of the site in the future may be industrial, recreational, and maybe residential. The risks for each of these uses was looked at and the baseline human health risk assessment for the area found that unacceptable risk levels for cancer exist in the area for industrial, recreational, and residential exposure scenarios unless remedial actions are taken. The greatest risk comes from external exposure to gamma radiation and two radionuclides, ^{137}Cs and ^{60}Co.

The ecological risk comes from contaminated soil and surface water. Of concern are the risks to mammals and other wildlife of radionuclide and nonradionuclide contaminants in the surface soil. Risk has also been assessed for plants and soil invertebrates. Surface water poses a risk for 16 of the 25 subbasins tested, though only five of the 16 were corroborated by biological data.

Summary of risks: Melton Valley contains areas with high inventories of radioactive wastes with long half-life radionuclides posing a potential risk for several areas. Several source areas contribute the majority of the tritium (^{3}H), ^{90}Sr, and ^{137}Cs to surface water. Most areas of contamination are associated with perennially inundated shallow land burial trenches. Surface water exceeds some AWQC and risk-based goals for the protection of human health and the environment. Radiologically contaminated surface soils are a significant problem in the valley, as shown by human health and ecological risk assessments. Hydrofracture wastes and wells require long-term site management. Groundwater exceeds MCLs throughout much of the Melton Valley watershed. TRU waste is located in several areas in the Melton Valley.

Summary of Actions Proposed

Present Worth:	$105 million
O&M:	$11 million
Years of Operation:	IHP Excavation (FY 2002)
	Hydrofracture Well P&A (FY 2003)
	Cap SWSA 4 (FY 2004)
	Cap SWSA 5 (FY 2007
	Cap SWSA 6 (FY2008)
	Pit and Trench Remediation (FY 2010)
	Complete ROD Actions (FY 2014)

The remediation goals summarized here aim to:

- Achieve AWQC in waters of the state;
- Protect an off-site resident user of surface water. This goal will be met 10 years from completion of actions in Melton Valley and Bethel Valley;
- Protect Clinch River to meet its stream use classification;
- Protect maintenance workers, industrial workers, and hypothetical recreational users. Recreational users are only partially addressed by this remedy and a subsequent ROD will fully address it; and
- Control releases from contaminated soil to reduce surface water exceedances and minimize further groundwater impacts.

Specific remedies to reach the remediation goals:

Buried waste sites, including TRU waste sites, pits and trenches

- Construct caps to cover buried wastes and associated contaminated areas;
- Construct barriers to surface water run-on, upslope stormflow intrusion into the site, and downgradient contaminated groundwater seepage;
- Treat all intercepted contaminated water to meet discharge requirements in SWSA 4, 5,and 6;
- Stabilize abandoned pipelines and trench backfill at cap boundaries;
- Design and construct all necessary water handing feature to prevent erosional impacts to adjacent land and stream channel areas;
- Plug and abandon all unneeded shallow wells and injection wells within the subject area, also plug deep wells using special plugging techniques;
- Design and implement a monitoring system for surface water and groundwater to demonstrate the performance of the remedial action components;
- Remove and manage contaminated soils in 23-trench area; and
- Create institutional controls and monitoring the hydrofracture grout sheets

Process Waste Sludge Basin and ponds

- Remove liquid, sludge, PVC liner, and 1ft (0.3 m)of soil beneath the PVC Liner;
- Plug both ends of the process liquid waste pipeline used to transfer waste between Bldg. 3544 to Process Waste Sludge Basin;
- Remove filled pond and contaminated soils including pond waters and sludge, that cause surface water criteria exceedances in the HRE tributary of Melton Branch; and
- Plug and abandon unneeded shallow wells within the project area.

HRE Fuel Wells

- Grout wells.

OHF, NHF, and MSRE and HRE ancillary facilites

- Remove contaminated contents, demolish buildings to ground level as appropriate; and
- Decontaminate and stabilize or remove subsurface structures as feasible.

Inactive waste transfer pipelines

- Plug outside of building foundations if foundations were not previously stabilized;
- Above-ground inactive waste lines will be removed;
- Isolate connecting pipelines by cutting line and capping;
- Main stem pipelines not under a multilayer cap will be stabilized; and
- Remaining secondary lines will be isolated, stabilized or removed.

Contaminated soils

- Hydraulic isolation or removal of contaminated soil;
- Deeper contamination will determine if removal or containment is appropriate; and
- Excavate floodplain soil in areas where gamma exposure measurements exceed 2,500 μR/hour.

Surface water quality

- Hydraulic isolation of most contaminant source units with selected waste removal or in situ treatment;
- Collection and treatment of contaminated groundwater at boundaries of waste containment areas; and
- Construct and operate one or more wastewater treatment facilities to treat contaminated groundwater to levels consistent with watershed water quality goals.

Moyer Landfill, Operable Unit 1

Site Name:	Moyer Landfill
ROD:	EPA/ROD/R03-85/018
Site Ownership:	Federal
Site Focus Location:	Landfill – Operable Unit 1
Contaminants of Concern:	Solid and liquid hazardous wastes, including polychlorinated biphenyls (PCBs), solvents, paints, and low-level radioactive wastes including traces of Radium-228, Strontium-90, and Technetium-99
Final Remedy:	The selected remedial action for this site includes interim soil clay capping, erosion and sedimentation control measures; surface water diversion; leachate collection, treatment and discharge; extraction, scrubbing and upgrading methane gas for delivery to the Philadelphia Electric Company (PECO); security/fencing measures; groundwater monitoring; institutional controls and all closure activities in compliance with RARA at the conclusion of the gas generation phase (10 to 20 years). ***See "Summary of Actions Proposed" below for further detailed information.***
EPA Region:	Region 3 - Pennsylvania.
Site Size:	64 acres (26.51 ha)
Waste Media:	Containerized in drums and incinerated materials in bulk, containing radionuclides, organics, and inorganics in varying amounts. ***See summary on deposited wastes for detailed information.***

Overview

The Moyer Landfill is an inactive, privately-owned landfill located in Montgomery county, Pennsylvania. The landfill was permitted for 65.5 acres (26.51 ha) in 1976, of which 45 acres (18.21 ha) had been used by 1977; however, some dumping did occur on unpermitted land. The site area consists of open land surrounded by wooded areas on steep slopes. Located on the site are leachate sumps, an office building, and a metal repair shed. Runoff from the slopes of the landfill flows westerly into Skippack Creek, which is located 350 ft (91.44 m) west of the site. The area immediately surrounding the landfill is comprised of scattered residential properties, while large residential developments are located within one mile of the site. The nearby Skippack Creek flows through Evansburg State Park, which bounds the site to the north.

According to local Federal Bureau of Investigation officials, the landfill, during its operation, accepted a variety of solid and liquid hazardous wastes, including polychlorinatedbiphenyls (PCBs), solvents, paints, low-level radioactive wastes, and incinerated materials in bulk form and/or containerized in drums. In 1972 when Pennsylvania Department of Environmental

Protection (PaDEP) rules and regulations became more restrictive, this landfill was cited, and was closed in 1981 and brought into receivership of the U.S. District Court. Since then, some remedial work has been done at the site under the direction of the receivership attorney, Ms. Joanne Denworth, appointed by the U.S. District Court under a 1982 consent order entered in a civil action initiated by neighboring residents. This work was carried out by SMC Martin. the receiver's consultant. They have performed certain activities including design of collection systems, completion of leachate treatability studies, and some site work including covering certain exposed areas of the landfill, regrading, and revegetation. Owing to increased involvement by local residents and PaDEP, the site was placed on the National Priority List (NPL) by the Environmental Protection Agency.

Description/History of Site

The site had been operated as a municipal landfill from the 1940's until April 1981, during which time it received municipal refuse and sewage sludge. In the early 1970's PaDEP developed and implemented more comprehensive landfill regulations. As a result, a leachate collection system was constructed and began operating in 1972 at the Moyer Landfill site. The collection system consisted of underground drainpipes placed on top of the bedrock at the toe of the landfill slopes. The leachate collected in these pipes drained by gravity to earthen basins, called "lagoon no. 1" and "lagoon no. 2," from which the leachate was to be pumped. The concrete basins were later converted to function as pumping stations. After the pumps were installed, the usable storage volume in the lagoons was reduced to one or two feet because a certain amount of leachate had to remain in the lagoons to prevent the pumps from running dry. Subsequent testing by PaDEP revealed that leachate-contaminated groundwater was appearing as a spring downgradient from the leachate collection pipe on the northwest side of the landfill. An additional pump station was then installed to intercept the springs and return this contaminated water to lagoon no. 2. Several force mains connected the collection system pumping stations to a concrete basin (which has since been abandoned) at the top of the landfill. From this basin, leachate was applied to the top of the landfill and disposed of by spray irrigation.

Because of increasingly stringent environmental regulations promulgated by the state of Pennsylvania during the mid-1970's, the owners of the landfill were prohibited from filling beyond the original boundaries. The landfill owners then submitted an application to the PaDEP requesting permission to expand the landfill boundaries. The original landfill was for an estimated 5 acres (2.0 ha). In the late 1970's, the landfill owners also submitted an application to the PaDEP for a major expansion to an area adjacent to the existing landfill, but PaDEP never approved this application.

In the original 39 acre (15.78 ha) fill area, the waste was simply dumped, compacted, and covered with earth. In the new fill area, the plans called for installing an impermeable liner prior to filling. Site preparation work began on the new area in 1977. Landfilling was reportedly limited to this new lined area until the landfill was closed by a PaDEP order in early 1981.

Later, leachate from the landfill was sampled extensively by PaDEP and to a lesser extent by EPA and by the operators of Moyer's Landfill. A wide range of heavy metals and organics were detected. In one situation sulfate concentration was found to be four times higher than EPA

maximum contaminant level. The heavy metals are indicative of sludge, both sewage and industrial that have been disposed on the site. The organics may have been components of certain industrial sludge (i.e. from the solvent recycling or plastics industries), but their probable origins cannot be determined at this time.

The EPA detected several hazardous compounds in leachate emanating from the Moyer Landfill site. These included benzene (2 to 4 ug/l), toluene (7 to 50 ug/l), Trichloroethylene (9 to 20 ug/l), tetrachloroethylene (0.1 to 0.5 ug/l) and chlorobenzene (1 to 3 ug/l). Other compounds detected by the EPA include ethylbenzene (2 to 20 ug/l), vinyl chloride (0.3 to 7 ug/l), methylene chloride (7 to 300 ug/l), chloroethane (0.7 to 2 ug/l), 1,1-dichloroethane (0.4 to 100 ug/l), and 1,1-dichloroethylene (1 to 2 ug/l). These volatile organics in the concentrated or pure forms are associated with industrial solvents.

Summary of Local Physical Conditions

Although access into and around the site is limited somewhat by a heavy growth of trees, steep slopes, streams, puddles and ponds, the site is still accessible by foot. The entrance to the site did have a fence and a gate at one time, limiting access to vehicular traffic. Elevations range from 275 ft (83.82 m) above mean sea level (MSL) along the west side of the site to 497 ft (151.5 m) above MSL at the top of the landfill. Drainage from the site flows in a westward direction into Skippack creek through direct runoff and also via small streams located north, south, and southwest of the site. Skippack Creek drains southwest into Perkiomen Creek approximately 3,000 ft (914.4 m) downstream from the site and is not used for municipal water supplies.

Groundwater in the site area occurs in an aquifer, which has poor water yields. The average depth of the wells in the area is 151 ft (46.02 m). Wells drilled into the deeper system are often artesian due to the dense, relatively impermeable layer of bedrock overlying the deep system.

Engineers conducted a soil and rock sampling, and monitoring well installation program at this site to define the geologic and hydrogeologic regime of the site and areas adjacent to the site. A total of thirteen monitoring wells have been installed. They consisted of four clusters of two wells each, one (1) deep and one shallow, located within 5 to 10 ft (1.524 to 3.0 m), from each other, and five additional wells which are interspersed around the boundary of the landfill site to give a broader perspective of the geology and hydrogeology of the site. The shallow wells are about 30 to 80 ft (9.144 to 24.38 m) deep, and the deep wells are approximately 250 ft (76.2 m) deep.

As indicated by the boring samples the Moyer landfill is situated on a high, resistive ridge of shale, argillite and siltstone of the Lockatong formation, of Triassic age. At some of the boreholes, the rock is disintegrated up to a depth of 40 to 80 ft (12.19 to 24.38 m), beyond which the formation is very dense.

Permeability testing of wells has indicated the permeability of the upper bedrock above 100 ft (30.48 m) is about 5 x 10-5 cm/sec while below 100 ft (30.48 m), the permeability decreases from 1 x 10-5 cm/sec to 5 x 10-7 Cm/sec. Groundwater movement from the vicinity of the landfill site is generally to the west with discharge around the toe of the fill and through seeps

along the steep valley of Skippack Creek. Hydraulic monitoring has demonstrated that Skippack Creek is a hydraulic boundary and no flow of leachate crosses the creek.

It is calculated that 95 to 98 percent of the contaminants flow in a lateral and a downgradient direction from the landfill site while 2 to 5 percent is vertical into the less permeable deeper aquifer zone. The rate of flow of groundwater through the fractures is in the range of 1 to 70 ft (0.3048 to 21.34 m) per day. Permeability measurements at the site confirm the other investigations. The rate of leachate generation has been estimated to be at an average rate of about 18,600 gallons (70.41 m^3) per day. A leachate collection system installed by the owners is in a poor state of repair and is now inoperable. Depending upon the year, excess leachate is generated and discharges to the Skippack Creek system during a period of 5 to 8 months each year.

Data was obtained from analysis of samples taken on two separate occasions, May 21 through June 1, 1984 and October 2 through 12, 1984. Samples were collected from onsite monitor wells along with offsite monitor and domestic wells. Six leachate and six seep locations from The landfill site were sampled for water and/or sediment. Water sediments and fish samples were collected from upstream and downstream locations in Skippack Creek passing along its western boundary. Groundwater samples from twenty-two residential wells and thirteen newly installed monitoring wells around the periphery of the site were sampled. These samples were analyzed for priority pollutants, PCBs, dioxins and radioactivity. The laboratory test results indicate that some contaminants observed in the leachate and seep samples from the landfill site are also present in water and sediment from the Skippack Creek, in the tissue of the fish sampled downstream of the landfill, and in monitoring wells surrounding the periphery of the landfill site.

Contaminant Transport

There are numerous seeps at the site that are either seeping lightly or leaching heavily contaminated water from the landfill. Eighty-six organic priority pollutants and sixteen priority pollutant metals have been observed in the samples from the site. There are three mechanisms of transport of the contaminants from the site: air, surface water and groundwater.

No detectable levels of contaminants are observed in the air at the site. Certain volatile contaminants such as toluene, xylene, and cyanide have been detected at the site, but have not been detected during air monitoring.

The groundwater level is lower than the bottom of the landfill. Therefore, groundwater is not the direct vehicle of contaminant transport from the site. The transport of contamination is mostly due to surface water percolation through the landfill. The exposed contaminants at the site are transported directly to the surface water bodies (Skippack Creek and Perkiomen creek) via surface runoff and indirectly through contaminated ground water (upper aquifer) discharging to the creeks. The lower aquifer is not contaminated. Beta radiation and other contaminants observed in the monitoring wells (mw8 and mw4) are the result of the transport route. Beta radiation and other contaminants could also be transported directly via the surface water runoff from the site to the surface water bodies. However, observed concentrations in these receptors are low due to the enormous dilution effect in the creeks. The shallow monitoring wells on the western boundary of the landfill show this contamination. The majority of the pollutants (Trichloroethylene, toluene, xylene, 2-hexanone, 2-butanone, acetic acid methylester) observed

in the monitoring wells and the surface water bodies have high mobility index and are consequently easily transported from the landfill site to these receptors.

Summary of Deposited Wastes

Onsite contamination

Six leachate and six seep samples were collected. Leachate samples were analyzed for 129 priority pollutants. One additional leachate sample was analyzed for radioactivity. The seep samples were analyzed for pH conductivity, oxidation-reduction potential and temperature. The landfill surface shows a number of leachate and seep locations. These are supposedly discharging several of priority pollutants and beta radionuclides into the surface water. Therefore, the landfill site is very unsafe for public trespass. It is a continuous source of polluting ground and surface water with several priority pollutants and radiation of probably hospital origin. The following is a summary of contamination observed at the site:

- The samples were observed to be contaminated with 86 priority pollutants and 16 metals. Although the concentration of most of these contaminants is low, nearly all of them are contaminants of concern;
- At least four (4) of the priority metals: arsenic, barium, lead and zinc, and eight of the organic priority pollutants: trichloroethylene, toluene, xylene, di-n-octylphthalate, 2-hexanone, and 2-butanone, bis (2-ethylhexyl) phthalate, are observed to be above ambient levels;
- Lead and barium exceed United States public health service drinking water standards;
- Beta radiation (technetium-99) is observed in the leachate sample and is above world health organization (WHO) standards. This contamination is suspected to be of hospital origin; and
- There is no evidence of any detectable level of air pollution.

Offsite contamination

Thirteen monitoring wells, twenty-two residential wells bordering the landfill site, Skippack Creek flowing by the western boundary of the landfill site, Perkiomen Creek accepting flow from Skippack Creek, and fish from Skippack Creek were sampled for priority pollutants, metals, organics, PCBs, dioxins, and beta radiation. The following is a summary of the contamination observed off the Moyer landfill site.

- The residential wells bordering the landfill site do not show any detectable levels of organic or inorganic pollution. This water meets all Federal EPA drinking water standards and is, therefore, safe for human consumption.
- The Skippack creek shows detectable levels of contamination. Those contaminants are: toluene, chloroform, 2-hexanone, bis (2-ethylhexyl) phthalate, di-n-octylphthalate, manganese, iron and possibly nickel. The concentrations of these contaminants are very low. However, these contaminants are present and their source can be traced back to the landfill. The creek water meets all Federal, EPA, and State of Pennsylvania drinking water WHO standards and is therefore safe as a raw water supply source.
- The fish in the creek also show detectable levels of contamination. The contaminants observed were lead, o-xylene, 2-hexanone, TCE, 2-butanone, toluene, di-n-octylphthalate. Again, the concentrations of these contaminants are very low.

None of these contaminants exceeds FDA standards of fish consumption of this fish by humans. The contaminants detected can be traced back to the landfill.

- The shallow monitoring wells installed around the periphery of the landfill site show substantial concentrations of some contaminants. These wells are located on the western boundary of the landfill site. The direction of groundwater flow is also to the west, northwest, and southwest. The contaminants of concern are arsenic, lead, barium, and nickel. The concentration of barium is 3,500 ug/l, whereas the US pH standard is 1,000 ug/l. The concentration of lead observed is 230 ug/l, whereas US pH is 50 ug/l. The US pH is considering revising the standard for lead. This is expected to be more stringent than 50 ug/l. Both barium and lead are toxic to humans. The arsenic concentration observed is 25 ug/l, whereas the US pH standard is 50 ug/l.
- Thirteen monitoring wells and one residential well were tested for radium 226, gross alpha and gross beta radiation. Monitoring well mw 5, 8, and 10 contained beta radiation varying from a 34.9+6 to 124+20.3 pCi/l. These three wells are shallow wells and are the most contaminated of the thirteen wells drilled at this site. The residential well water indicated very low levels of radiation including beta radiation. The standard guideline for beta activity is 27 pCi/l.

  Evidently the radiation activity in monitoring well water far exceeds the maximum recommended for drinking water. In order to make a proper health and environmental impact of this contaminant, it is essential to determine the exact nature of this contaminant at its isotope level and also possibly identify its source. For this purpose, samples from these wells were collected again. The analytical test results are indicated in tables 1.
- Potassium-40 is a naturally occurring isotope that may have been contributed by the large amount of suspended material present in the collected samples. The technitium-99 may be attributed to hospital wastes buried at the site.
- The shallow groundwater is also contaminated with several of the other organic contaminants found in the creek water, sediments, and fish. Therefore, the shallow groundwater, which flows west and northwest of the landfill site is substantially contaminated.
- The vegetation and trees on the western boundary of the landfill site show stress.

Discussion of Issues Leading to the ROD

According to available information, the first three decades of operations at the Moyer Landfill were marked by minimal community interest. However, in 1977, when the operators of the landfill sought to expand the site from 44 acres to 185 acres (17.81 to 34.4 ha), residents in the vicinity of the landfill joined together and formed a group called the Lower Providence Concerned Citizens (LPCC) to fight the expansion plans. In addition to stopping the growth of Moyer Landfill, the LPCC demanded that the existing site be closed.

LPCC concern over what was perceived as the PaDEP indifference to citizen's complaints, and to obvious violations of state and federal environmental laws at the Moyer Landfill site, led to the filing of a civil suit in federal court in June 1980. The LPCC was joined in this effort by

approximately 100 individuals and several local civic and sportsmen's groups, including the League of Women Voters of the Valley Forge (Pennsylvania) area, the Valley Forge Audubon Society, and the Country Boy Bass Association. The original suit named the PaDEP, as well as the owners and operators of Moyer Landfill, Inc., as defendants; but the suit was dismissed. Later, a combined suit was filed by the citizens and organizations mentioned above and the PaDEP against the owners and operators of Moyer Landfill, Inc.

Although the early years of LPCC existence were marked by difficulties with local government, the organization and other residents are pleased with the present elected officials and report a good working relationship with them. The community's relationship with the PaDEP can be characterized as cautious. Local officials and residents were satisfied when the EPA began investigating the Moyer Landfill site, but both groups are unsatisfied with the duration of the RI/FS process and have demanded effective clean up action as soon as possible.

Summary of Actions Proposed

After careful review and consideration of site areas identified in the remedial investigation that warrant remedial action, and of all alternatives developed by EPA in the feasibility study and the alternative developed by the site receiver in the addendum to the feasibility study, the site receiver's methane gas generation/recovery alternative can be implemented at the Moyer Landfill site. This phased alternative will meet the Superfund goals of minimizing present and future migration of hazardous substances and protect human health and the environment, while also attaining all applicable and relevant Federal public health and environmental standards, guidance and advisories at the point of closure (10 to 20 years). Specifically this option proposes;

- Soil cover with a permeability of $10^{-4}/10^{-5}$ cm/sec;
- Erosion and sedimentation control measures;
- Surface water diversion;
- Leachate collection, treatment and discharge;
- Methane gas recovery and sale;
- Security/fencing measures;
- Groundwater monitoring; and
- All closure activities in compliance with RCRA at the conclusion of gas generation phase (10 to 20 years).

Total capital cost for the selected remedial alternative is estimated to be $6,298,500 with O&M costs approximately $343,100 per year.

This Alternative contemplates broad remedial work and its implementation will depend upon the success of the gas generation/recovery program and the contributions from generators and other potentially responsible parties (PRPS). If negotiations with the PRPS fail and/or the methane gas alternative fails, EPA and PaDEP recommend remedial action Alternative 2. This Alternative is a cost-effective remedy and, like the selected remedy, will satisfy all of the contamination and migration objectives identified in the remedial investigation. Specifically, Alternative 2 proposes:

- Miscellaneous work preparatory to installations of RCRA cap; grading, flattening of steep slopes, retaining walls and installations of rip-rap at areas that are most likely to be eroded;
- Gas venting and gas monitoring;
- Surface water collection and discharge to Skippack Creek;
- Leachate collection and treatment that will meet the 10^{-6} risk level in the groundwater and discharge requirements in the stream; and
- Operation and maintenance; ground and surface water monitoring, maintenance of the cap and treatment of leachate.

The capital costs of construction and annual operation and maintenance costs of the backup remedial Alternative (Alternative 2) are as follows:

1. Soil/clay 10^{-7} cap *	$9,308,400
2. Run off collection and discharge	330,000
3. Gas vent system	331,800
4. Access road for maintenance purpose	108,000
5. Leachate collection **	4,650,000
6. Leachate treatment	656,600
Total capital costs	$15,384,800
Annual Operation and Maintenance	343,100

* This cap does not include a 20 mil. synthetic liner.
** Design parameters which directly affect the size of the system and quantities of the materials required influence costs. Trench depth is the most cost-influencing factor. The exact depth of the collection system will be based on coring results developed in the design phase and a fate and transport model to determine the amount of leachate that needs to be treated to maintain discharge requirement levels into the Skippack Creek 10^{-6} risk levels in groundwater.

Present Worth:	$33,553,000
O&M:	$343,100
Months of Operation:	120 to 240

Weldon Spring Site Remedial Action Project, Overview

The U.S. Department of Energy's Weldon Springs Plant/Quarry was listed on the National Priorities List (NPL) on June 24, 1988. The Weldon Springs site is divided into two noncontiguous areas that consist of a chemical plant and lime quarry. The sites are viewed as one under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) because they are closely related in history and purpose, they are located in close proximity to one another, and the remediation approach used for the sites was similar. Activities at the chemical plant and quarry during the 1940's through the 1960's caused the site to become radioactive.

Description/History of Site

The Weldon Spring Site is located in St. Charles County, Missouri, near the city of Weldon Spring, about 30 mi (48 km) west of St. Louis, Missouri. In 1941, the Department of the Army acquired close to 17,000 acres (7,000 ha) of the land to construct Weldon Spring Ordnance Works. From 1941 to 1946, the Army used the ordnance works to produce trinitrotoluene (TNT) and dinitrotoluene (DNT) explosives.

The Weldon Spring Site contains a limestone quarry. The quarry covers an area of about 9 acres (3.6 ha). Prior to 1942, the quarry was mined for limestone that was used to support various construction activities in the area. The Army later used the quarry to dispose of the chemically contaminated materials from the ordnance works. The ordnance works was eventually closed and declared surplus to the Army's needs in 1946. Three years after the ordnance was closed down all but 2,000 acres (810 ha) of the land was transferred to the State of Missouri and the University of Missouri.

In 1955, the Atomic Energy Commission (AEC), a predecessor to the Department of Energy (DOE) acquired 205 acres (83 ha) of the Weldon Spring's property. Shortly after this time the AEC constructed a feed material plant, now referred to as the Chemical Plant, that covers an area of about 217 acres (88 ha) on the property to process uranium and thorium ore concentrates. In 1960, after acquiring the quarry from the Army, the AEC began to dispose of uranium and thorium residues (both drummed and uncontained), radioactively contaminated building rubble, and process equipment into the quarry. The quarry is about 4 mi (6.4 km) south-southwest of the chemical plant. AEC closed the chemical plant in 1967 and returned the land back to the Army. The property was returned to AEC in 1985. In 1987, the Environmental Protection Agency (EPA) placed the Weldon Spring Quarry on its National Priorities List. Two years later, EPA expanded the list to include the chemical plant at which time the official name of the site become known as the "Weldon Spring Quarry/Plant site."

Summary of Local Physical Conditions

The Weldon Spring quarry is surrounded by the Weldon Spring Wildlife area, which is managed by the Missouri Department of Conservation. The vegetation at the quarry consists of grass, shrubs, and tress. Agricultural crops are also grown on much of the land south of the quarry. The quarry was excavated into a limestone bluff that forms a valley wall at the edge of the Missouri River alluvial floodplain. This limestone formation has numerous cracks and fissures.

The main floor of the quarry comprises an area of 2 acres (0.8ha) and contained about 3,000,000 gal (11.36 million liters) of pond water, which covers an area of 0.5 acres (0.2 ha). There are several waterways located in close proximity to the quarry. For example, the Missouri River is located 1 mi (1.6 km) to the southeast of the quarry, the Little Femme Osage Creek is located to the west, an unnamed tributary of Little Femme Osage Creek to the north, and the Femme Osage Creek to the southwest.

Weldon Spring Site Remedial Action Project, Quarry

Site Name:	Weldon Spring Quarry
ROD:	EPA/541/R-98/166
Site Ownership:	Federal
Site Focus Location:	Quarry proper, the Femme Osage Slough and nearby creeks, and quarry groundwater north of the Femme Osage Slough.
Contaminant of Concern:	Inorganics, metals, nitroaromatics, PAHs, PCBs, and radioactive materials
Remedy:	Implement a long-term groundwater monitoring strategy to verify the condition of the quarry area and St. Charles County. Also, implement controls to prevent uses of the site that would adversely affect contaminant migration. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 7 – Missouri
Site Size:	9 acres (3.6 ha)
Waste Media:	Groundwater, sediment, soil, and surface water

Summary of Deposited Wastes

The contaminated media at this site can be categorized into three separate entities: the residual contamination at the quarry proper, the Femme Osage Slough and nearby creeks, and quarry groundwater north of the Femme Osage Slough.

Soil samples taken from the rims and slopes at the quarry proper contained contaminants of several metals, radionuclides, nitroaromatic compounds, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Soil taken from the rim and knoll of the quarry contained silver, zinc, radium-226, thorium-230, and uranium-238. These contaminants were detected at concentrations significantly higher than background levels.

Surface water and sediment samples from the upper and lower reaches of the Femme Osage Slough, Little Femme Osage Creek, and the downstream portion of Femme Osage Creek contained contaminants of uranium-238 and metals. Small concentrations of nitroaromatic

compounds were also detected in the surface water. In general, contaminant concentrations were lower in the creek than in the slough.

Data was also collected from the groundwater underlying the quarry area. The primary contaminants in the quarry groundwater north of the slough are uranium and nitroaromatic compounds. The highest concentrations of uranium were detected in wells along the southern rim of the quarry.

Discussion of Issues Leading to the ROD

The Department of Energy decided that no further remediation is necessary to protect human health and the environment at the Weldon Spring Site. They felt that previous remedial actions have removed the contaminants at the Weldon Spring Site and as a result no new migration of contaminants should reach the groundwater system. They decided to take this remedial action because there are still significant levels of uranium in quarry groundwater located north of the slough, which is in close proximity to the St. Charles County well field. This ROD allows the DOE to find an effective way to reduce or remove the uranium from the quarry groundwater so that it does not migrate towards the well field.

Summary of Actions Proposed

Estimated Capital Cost:	$150,000
Estimated Annual O&M:	$600,000
Present Worth:	Information not provided

The selected remedy for this site will implement the following actions:

- A long-term groundwater monitoring strategy will be implemented to confirm expectations that significant impacts to the Missouri River alluvial aquifer will not occur and that conditions at the quarry area will continue to be protective of human health and the environment;
- Institutional controls will be necessary to prevent uses inconsistent with recreational use, or uses that would adversely affect contaminant migration. DOE will continue to coordinate with the Missouri Department of Conservation and the Missouri Department of Natural Resources-Parks to establish a written agreement outlining and agreeing to the terms of the institutional controls. The terms in the agreement may include limiting access to groundwater north of the slough for the following uses: irrigation, consumption, or as a surface water source. The terms of agreement should be evaluated at each five-year review;
- The quarry proper will be restored though backfilling with soil to reduce fall hazards, stabilize the high walls, eliminate ponding of surface water, and minimize infiltration through the inner quarry area to the ground water;
- Monitor the quarry groundwater to verify that conditions in the quarry area and the well field remain protective of human health and the environment. Conduct routine sampling of the groundwater to determine if uranium and nitroaromatic levels are increasing due to contaminant migration; and

- DOE will continue to collect data for two purposes: to determine the effectiveness of groundwater remediation and to define the extent of radiological soil contamination at the northeast slope and ditch area at the quarry proper.

Weldon Spring Site Remedial Action Project, Quarry

Site Name:	Weldon Spring Quarry
ROD:	EPA/ROD/RO7-90/043
Site Ownership:	Federal
Site Focus Location:	Bulk wastes buried on the quarry grounds
Contaminant of Concern:	Organics including PCBs and PAHs; radioactive materials; and metals including arsenic and lead.
Remedy:	The **interim remedial action** for the site includes excavating an estimated 95,000 yd^3 of chemically and radioactively contaminated bulk wastes from the quarry and temporarily storing the wastes onsite in the chemical plant area. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 7 – Missouri
Site Size:	9 acres (3.6 ha)
Waste Media:	95,000 yd^3 (73,000 m^3) of bulk wastes, which consisted of soils, sludge, equipment, and structural debris

Summary of Deposited Wastes

The estimated 95,000 yd^3 (73,000 m^3) of bulk waste, which consists of soils, sludge, equipment, and structural debris, in the quarry is radioactively contaminated. The surface elevation of waste in the quarry is about 480 ft (145 m). The materials disposed in the quarry consist of wastes from the chemical plant as well as wastes brought in from other areas, including materials associated with the processing of uranium and thorium concentrates, uranium and radium-contaminated rubble, high-thorium-content materials, and 3.0% residues.

Radioactive contamination of the entire quarry covers an area of about 171,000 ft^2 (15,900 m^2) and extends to an average depth of about 13 ft (4 m). The radioactive contamination on the main floor of the quarry covers an area of almost 60,000 ft^2 (5,600 m^2) and extends to depths of about 40 ft (12 m). The radioactive contaminants of concern at the site are those associated with the uranium-238 and thorium-232 decay series.

In each of the uranium-238 and thorium-232 decay series, one member of the series is a gas (radon-222 and radon 220). Elevated concentrations of radon-222 and radon-220 and their short-lived decay products have been measured in the atmosphere within the quarry and at the quarry fence. The annual average concentration at the fence line varies from year to year and has averaged about 2pci/1 over the past few years. The most energetic form of electromagnetic radiation emitted by radionuclides is the gamma ray. Elevated gamma exposure rates have been measured at the quarry fence and within the quarry. The gamma exposure rate within the quarry averages 60 μR/hr and the maximum measured rate is 625 μR/hr.

Nonradioactive contaminants have also been detected in the quarry bulk wastes. A chemical characterization study was conducted at the quarry in 1986. Nitroaromatic compounds, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs) were detected in the samples taken from the17 boreholes at the quarry. Three more samples were taken from the northeastern corner of the quarry in 1987 which showed signs of nitroaromatic compounds. The characterization results of the samples indicate that chemical contamination is present throughout much of the quarry bulk wastes and that the distribution of the contaminants is highly heterogeneous. Another indication is that most of these chemical contaminants are found at depths of less than 12 ft (3.6 m).

Discussion of Issues Leading to the ROD

The Weldon Spring Site is a former ordnance works and chemical plant. Since the 1940's, the site has been used by various government agencies for chemical and ordnance processing with chemical and radioactive waste disposed in the quarry. In 1984, the Army participated in a project to decontaminate the site. They took steps to repair several of the buildings at the site, to decontaminate some of the floors, walls, and ceilings, as well as removing some of the contaminated equipment to areas outside of the buildings.

In May 1985, the Department of Energy initiated cleanup activities at the site. They designated control of the site and decontamination of the Weldon Spring site as a major Federal project under its Surplus Facilities Management Program. Then, in 1987, the Environmental Protection Agency listed the quarry on the National Priorities List (NPL).

The main source of contamination within the quarry are the bulk wastes. Studies have shown that the groundwater at the quarry contains elevated concentrations of chemical and radioactive contaminants. The contaminants are migrating through the fractured walls and floor of the quarry into the underlying groundwater. This raises the concern that if the contaminants are not removed they could get into the drinking water. The actual or threated release of hazardous substances from the quarry also raised issues about the possible human health and environmental problems that could come from exposure to the bulk wastes buried in the quarry.

Summary of Actions Proposed

Present Worth:	$11 million
O&M:	No costs associated with this remedial action

The interim remedial action for the quarry involves excavating the bulk wastes from the quarry and transporting them along a dedicated haul road to the chemical plant area. The bulk wastes would be unloaded and temporarily stored in an engineered facility pending a final decision on how to dispose of all the wastes from the Weldon Spring Site.

It was decided that the interim remedial action for the site would include excavating an estimated 95,000 yd^3 (73,000 m^3) of chemically and radioactively contaminated bulk wastes from the

quarry and temporarily storing the wastes onsite in the chemical plant area and implementing site access restrictions. This action will eliminate the bulk wastes as a potential continuing source of groundwater contamination and minimize the risks associated with exposure to contaminants released into the air.

The major components of the selected remedy included:

- Removing the bulk wastes from the quarry using standard equipment and procedures;
- Transporting the bulk wastes along a dedicated haul road to the chemical plant area of the Weldon Spring site; and
- Placing the bulk wastes in controlled storage in an engineered temporary storage facility.

This remedial action will also facilitate additional characterization of the wastes and residual contamination in and around the quarry. After the wastes have been removed, a detailed study will be conducted on the empty quarry and local groundwater system. The results of the study will be used to determine what remedial action can be taken to deal with the residual materials remaining in the quarry walls and fissures, groundwater, and the contaminated properties located outside of the quarry.

Weldon Spring Site Remedial Action Project, Raffinate Pits

Site Name:	Weldon Spring Site
ROD:	EPA/ROD/RO7-93/067
Site Ownership:	Federal
Site Focus Location:	Four raffinate pits, Frog Pond, Ash Pond, and the north and south dump areas
Contaminant of Concern:	PAHs and PCBs; metals, including arsenic, chromium, and lead; other inorganics, including asbestos; and radioactive materials
Remedy:	883,000 yd^3 (675,000 m^3) of contaminated sludge, soil, sediment, structural material, vegetation, and process waste from the two water treatment plants would be removed from the source areas to on-site storage areas. ***See summary of actions proposed for this ROD for further detailed information.***
EPA Region:	Region 7 – Missouri
Site Size:	217 acres (88 ha)
Waste Media:	Soil, sludge, sediment, and debris

Summary of Local Physical Conditions

The chemical plant consists of 40 buildings, the 26 acre raffinate pits, the 11 acre Ash Pond, the 0.7 acre Frog pond, two former dump areas (north dump and south dump), a woodlands area, and a wetlands area. Most of land surfaces around the buildings are paved or covered with gravel and the remaining areas are covered with grass, scattered small shrubs and trees. Much of the site is routinely mowed, and little undisturbed and/or natural habitat exists except in the northern quadrant. The U.S. Soil Conservation Service has classified certain portions of the chemical plant site as prime farmland soil on the basis of soil type, slope, and drainage in the area.

The four pits and two ponds combined cover about 38 acres (15 ha) and are included on the Department of Interior's Wetlands Inventory Map. Surface runoff from the southern portion of the site flows south toward the Missouri River via 1.5 mi (2.4 km) of natural channels, referred to as the Southeast Drainage. The runoff from the rest of the site flows north toward the Mississippi River.

Summary of Deposited Wastes

The radioactive contaminants found at the site are primarily radionuclides of the natural uranium and Th-232 decay series. The chemical contaminants include naturally occurring metals and inorganic anions, as well as organic compounds such as polychlorinated biphenyls (PCBs) and nitroaromatic compounds.

Various locations throughout the chemical plant area contain elevated concentrations of certain metals and a few organic compounds. The soil in the north dump, south dump, and at other locations throughout the plant is radioactively contaminated. One of the most heavily contaminated areas is the raffinate pits. The raffinate pits cover about 26 acres (10 ha) and they contain close to 200,000 yd^3 (150,000 m^3) of sludge and a combined average of 57,000,000 gal (216,000 m^3) of water.

A few off-site locations were also contaminated as a result of the surface runoff and groundwater discharge from the chemical plant. These off-site locations include Burgermeister Spring and three lakes in the Busch Conservation Area and 10 vicinity properties, one of which is the Southeast Drainage. The surface water and sediments in the area were contaminated with uranium and nitrate and the soil at the vicinity properties contained uranium, thorium, and radium.

Discussion of Issues Leading to the ROD

The Weldon Spring site is a former ordnance works and chemical plant. Since the 1940's, the site has been used by various government agencies for chemical and ordnance processing with chemical and radioactive waste disposed of in the quarry. In 1984, the Army participated in a project to decontaminate the site. They took steps to repair several of the buildings at the site, to decontaminate some of the floors, walls, and ceilings, as well as removing some of the contaminated equipment to areas outside of the buildings.

In May 1985, the Department of Energy initiated cleanup activities at the site. They designated control of the site and decontamination of the Weldon Spring site as a major Federal project under its Surplus Facilities Management Program. Then in 1987, the Environmental Protection Agency listed the quarry on the National Priorities List (NPL) and the chemical plant area was added to this listing in 1989.

The chemical plant area has been extensively studied to determine the nature and extent of the contamination in various media. The results of the DOE's *Remedial Investigation for the Chemical Plant Area of the Weldon Spring Site* (RI) (DOE 1992b), identified the primary mechanisms and transport pathways for the site as:

- Surface runoff from on-site areas to off-site drainage soil and surface water;
- Surface water loss to groundwater via losing streams off site;
- Groundwater discharge to surface water via gaining streams off site;
- Leaching from contaminated surface and/or subsurface soil, sediment, or sludge to groundwater;
- External gamma radiation from radioactively contaminated surfaces, including building material and soil; and
- Atmospheric dispersion of radon from radium-contaminated soil.

Due to the chemical plant's proximity to the Missouri River, to two State conservation areas, and to a small town, it was important to deal with the human health and environmental problems that could come from being exposed to contaminates at the site.

Summary of Actions Proposed

Present Worth:	$78.5 million
O&M:	$23.9 million
Months of Operation:	360

Contingency Remedy

Present Worth:	$96.9 million
O&M:	$23.9 million
Months of Operation:	360

Key components of this interim remedial action include:

- Materials will be removed from contaminated areas, treated as appropriate by chemical stabilization/solidification, and disposed of in an engineered disposal facility constructed on site. Chemical stabilization/solidification will used to treat the contaminated sludge (such as the raffinate pit sludge), certain quarry soil and sediment, and other contaminated soil from the site. Treated and untreated materials will be disposed of on site in an engineered disposal facility constructed for the Weldon Spring site.
- The cleanup effort will include efforts to dredge 220,000 yd^3 of sludge from the raffinate pits and excavate 119,800 yd^3 of contaminated sediment from Frog Pond and Ash Pond and three off-site lakes. In addition, the remedial action will excavate 339,000 yd^3 of contaminated soil from specific locations (including two former dump areas, locations adjacent to the chemical plant buildings, and 10 vicinity properties off-site). The waste will then be transported to the on-site treatment facility using standard construction equipment.
- Remove materials stored at the temporary facilities on site (including bulk waste excavated from the quarry, treatment residuals from the water treatment plants at the quarry and the chemical plant area, and building material from the chemical plant area) using standard construction equipment and procedures.
- Treat approximately 30,650 yd^3 of contaminated vegetation using biodegradation, followed by on-site disposal.
- Vitrification of the contaminated sludge, soil, and sediment is being evaluated as a contingency treatment option.

Preliminary Analysis

Site/ROD*	Landfill	Buried Waste	TRU isotopes/ actinides	Non-TRU radioactive waste	Organic waste	Inorganic waste	Physical Environment	Waste left in-place	Long-term monitoring	Institutional Controls
Hanford EPA/ROD/R10-95/126; EPA/541/R-97/044		•		•	•	•	•	•		
Hanford 300 Area EPA/ROD/R10-96/143	•	•		•	•	•	•		•	•
Hanford 100 Area EPA/541/R-99/112		•	•	•		•	•	•		•
Hanford 300 Area ROD not yet issued		•	•	•	•	•	•		•	•
INEEL EPA/ROD/R10-93/070		•	•	•	•	•	•	•	•	•
INEEL EPA/ROD/R10-96/132, EPA/ROD/R10-96/147		•	•	•			•	•	•	•
FERNALD EPA/ROD/R05-95/286		•	•	•	•	•			•	•
FERNALD EPA/ROD/R05-95/289	•	•	•	•	•	•			•	•
Maxey Flats EPA/ROD/R04-91/097		•	•	•		•		•	•	•
Melton Valley Watershed DOE/OR/01-1826&D3	•	•	•	•	•	•		•	•	•
Moyer Landfill EPA/ROD/R03-85/018	•			•	•	•		•	•	•
Paducah Gaseous Diffusion Plant EPA/ROD/R04-95/235		•		•	•	•		•	•	•
Weldon Spring EPA/ROD/R07-90/043		•		•	•	•			•	•
Weldon Spring EPA/ROD/R07-93-067		•		•	•	•			•	•
Weldon Spring EPA/541/R-98/166										

*The study team, in constructing the summaries of the selected Records of Decision, has generated the above graphic to aid in the analysis of its findings.

Waste Comparability

The types of waste identified during this scoping and identification process are broadly reflective of the types of waste stored at WAG 7. Most of the sites display combinations of transuranic isotopes and actinides, low-level radioactive wastes, organic wastes, and inorganic wastes

resulting from activities around the DOE weapons complex. Only the Maxey Flats ROD specifically calls out the presence of transuranic waste. However, other RODs speak to the presence of transuranic isotopes and actinides.

The concentrations of the transuranic isotopes and elements discussed in the selected RODs, however, are significantly lower than those found at WAG 7. With the exception of the Maxey Flats site, none of the other RODs details the presence of TRU isotopes and actinides in concentrations that would have them classified as TRU waste. However, the definition of TRU has evolved in the past – the separation and retrievable storage of waste at WAG 7 that contain transuranic isotopes and actinides, but that are not defined as TRU waste, speaks to the possibility of further evolution of the definition of TRU waste. A detailed breakdown of the contaminants of concern by site is provided in Appendix C.

There is little doubt in reviewing the selected RODs that DOE faces considerable challenges given the unusual (even within the DOE complex) mixture of wastes found at WAG 7. Although many of the waste combinations found in the selected RODs are passingly similar to those found at WAG 7 (TRU isotopes and actinides in close proximity to, or mixed with, organic and nonorganic potential contaminants of concern), the sheer volume and activity of WAG 7 waste types renders meaningful comparisons moot.

Waste Placement Comparability

The RODs reviewed in this study describe what could be considered traditional waste emplacement types, to include trenches, pits, cells, etc. Much as can be seen at WAG 7, these waste emplacement types are found to be both lined and unlined and to vary in physical dimension, volume, and the types of wastes they accept.

Outside of the Hanford site, none of the selected RODs proposes remedies for waste volumes approaching those found at WAG 7. Several of the sites, however, do possess a variety of waste emplacement types – the Maxey Flats site, for example, has both wastes trenches and so-called 'hot cells,' while the FERNALD site possesses a landfill, waste trenches, and a contaminated flyash pile.

Waste forms addressed in the RODs are not homogeneous – the RODs discuss large contaminated metal structures, sludges, liquids, containerized wastes (in drums, cardboard and wooden boxes, and steel crates, among others), placed soils, and just about every other form that could be dumped, thrown, or poured into an emplacement feature (including several 'misplaced' fuel rod elements found strewn about a waste site at Hanford).

In regard to waste emplacements, WAG 7 is not unique in its combination of emplacement features, non-homogeneous waste types, and emplaced volumes.

Physical Environment Comparability

With the exception of perhaps the Hanford Site, none of the physical features at the sites addressed in the summarized RODs bear much resemblance to those found at INEEL. The sites generally receive more rainfall than INEEL, have higher water tables, are in the vicinity of surface water features, possess more moderate climates, and have significantly different subsurface structures and composition. In addition, the population densities at most of the sites are higher than those found at INEEL (granted, these sites' surrounding environments are all, by and large, rural, but the INEEL is particularly isolated from surrounding communities). The climatic conditions found at all the sites (with the exception of Hanford and INEEL) force considerable focus to be paid to precipitation-induced contaminant leaching and runoff. With the exception of the Hanford site and perhaps Savannah River, none of the sites offers a buffer zone equivalent to that found at INEEL. That notwithstanding, every site possesses some type of DOE-owned buffer zone, and several also have federal or state-owned recreational or grazing lands outside of the DOE buffer zone. These lands provide an additional layer of isolation for the waste sites and an additional physical impediment to trespassers.

Remedies

With the exception of Hanford's observational approach and plug-in approach, and the work detailed at INEEL's Pit 9, the remaining RODs present tried and true remedial actions. With these exceptions, no ROD summarized above specifically mentions the use of novel or innovative technologies or procedures for remediation. However, the opportunity to use such technologies is left open, as the RODs include caveats suggesting that novel technologies may be evaluated for use in the future. The remedial actions contained within the selected RODS include:

- Waste excavation, dewatering, and stabilization (Fernald OU1);
- Waste extraction, solidification, and on-site disposal (Maxey Flats, Hanford 100-Area and 300-Area, Fernald OU2);
- Installing and maintaining caps (INEEL SL-1 and Borax-I, Maxey Flats, Paducah);
- Monitoring groundwater (Maxey Flats, Paducah, Fernald OU2);
- Employing institutional controls;
- Construction of waste processing and loading facilities and equipment; and construction of on-site disposal facility (Fernald OU1 and OU2); and
- Off-site disposal of waste (Fernald OU1 and Fernald OU2).

Of perhaps considerable interest and relevance to WAG 7 are the RODs that speak to leaving above-health-level wastes in place at the site. This remedy can be seen in both the Hanford 100Area ROD (the ROD provides a decision framework to evaluate leaving some contamination in place at a limited number of sites, particularly where contamination begins at depths below 15 feet) and in the Maxey Flats ROD (where the decision to leave waste in place was based on the unacceptably high doses of radiation to site workers that exhumation and off-site disposal would pose).

The Maxey Flats site does not possess the large buffer zone characteristic of both the Hanford and INEEL sites, so the decision to leave waste in place is all the more noteworthy. Although the

waste discussed in these two RODs are not identical to those characteristic of WAG 7's wastes, preliminary evaluation of these waste types would suggest that they are less virulent than those found at WAG 7. If one can make an argument that *not* moving dangerous wastes is an acceptable remedy (albeit with the requisite five-year reviews), then perhaps the argument can be made than *not* moving *more* dangerous wastes (i.e., of the type found at WAG 7) could also be an acceptable remedy. The Maxey Flats site does not possess the deep vadose zone characteristic of the INEEL site nor does the ROD make mention of an aquifer beneath the site. However, there are several surfacewater pathways at the site.

Incorporating a decision framework through which a decision can be made to leave waste in place appears to be an important precedent. The Hanford site is analogous to the INEEL site in many respects, including, among others, the types and volumes of waste at the site and the site's subsurface characteristics. Should this decision framework be applied at Hanford, a precedent would be set for leaving deep wastes in place, providing that the public health and environment can be adequately protected given the range of institutional controls, monitoring, and modeling technologies available to site managers.

The observational approach utilized at the Hanford site may also provide important precedent for remediation work at WAG 7. Utilization of the observational approach at INEEL, supported by recently-improved record keeping of wastes emplaced at WAG 7, offers the potential of both time and money savings during remediation. Important regulatory agency "buy-in" of the approach at Hanford may permit a more rapid adoption of this methodology at INEEL.

Prevailing Factors Behind Remedy Selection

In reviewing the Records of Decision summarized in this document, the study team endeavored to discern the prevailing deciding factors behind the selection of remedies. While there are numerous criteria that a selected remedy must meet, certain of these criteria may play a greater role in the decision making process than others.

In reviewing the Records of Decision to discern the prevailing factors behind the selection of a given remedy, the study team relied heavily on the ROD sections that detail the comparative analysis of alternatives. Many RODs provide this information in tabular format, while others rely more heavily on text-based discussions. In many cases, two or more proposed alternatives presented similar attributes in terms of their ability to meet the threshold, balancing, and modifying criteria listed in the RODs. In these cases, the deciding factors listed below represent the advantages that the selected remedy presented over competing alternatives. The magnitude of these advantages is not presented here. The following reflect the study team's best judgment regarding these deciding factors. They are presented in no particular order.

Site	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementatiblity	Cost	State Acceptance	Community Acceptance
Hanford EPA/ROD/R10-95/126; EPA/541/R-97/044			•	•					
Hanford 300 Area EPA/ROD/R10-96/143			•						
Hanford 100 Area EPA/541/R-99/112			•				•		
Hanford 300 Area ROD not yet issued									
INEEL EPA/ROD/R10-93/070									
INEEL EPA/ROD/R10-96/132, EPA/ROD/R10-96/147					•	•	•		
FERNALD EPA/ROD/R05-95/286			•			•	•		
FERNALD EPA/ROD/R05-95/289						•	•		
Maxey Flats EPA/ROD/R04-91/097			•	•	•	•	•		
Melton Valley Watershed DOE/OR/01-1826&D3			•		•	•	•		
Moyer Landfill EPA/ROD/R03-85/018									
Paducah Gaseous Diffusion Plant EPA/ROD/R04-95/235					•				
Weldon Spring EPA/ROD/R07-90/043				•	•		•		
Weldon Spring EPA/ROD/R07-93-067						•	•		
Weldon Spring EPA/541/R-98/166							•		

In addition to the above, several factors that do not easily fit into these criteria categories appear to have played a role in the alternative selection process. At Hanford, the permanence of the alternative (EPA/ROD/R10-95/126; EPA/541/R-97/044; EPA/ROD/R10-00) and the desire to move contaminants away from the Columbia River and groundwater (EPA/ROD/R10-96/143) played roles in the alternatives selection process. In addition, two Hanford RODs (EPA/ROD/R10-95/126; EPA/541/R-97/044; EPA/ROD/R10-00) mention the permanence of the selected remedy as a deciding factor. In the reviewed Paducah ROD, a reduced timeframe required to reach remediation objectives was listed as an advantage that the selected remedy possessed over competing alternatives. At Weldon Springs (EPA/ROD/R07-90/043), the selected remedy displayed an advantage over competing alternatives in the time that it would

require to reduce the mobility of contaminants. In the Maxey Flats ROD, the selected remedial action is discussed as being an extension of currently in-progress work – this is mentioned as an advantage over competing alternatives.

Several of the down-selected RODs contain remedies that entail leaving wastes in-place (or making provisions to do so in the future) as opposed to removing and treating the wastes. These RODs (and the reasons behind the decision to leave wastes in place) include:

Site	Reasons for leaving waste in-place
Hanford EPA/ROD/R10-95/126; EPA/541/R-97/044	• Reduction of risk through decay • Protection of human health and the environment • Worker safety • Cost in comparison to competing alternative remedies
Hanford 100 Area EPA/541/R-99/112	• Reduction of risk through decay • Protection of human health and the environment • Worker safety • Cost in comparison to competing alternative remedies
INEEL EPA/ROD/R10-93/070	• Ease of implementation • Cost in comparison to competing alternative remedies • Reduction of toxicity/mobility/volume through treatment
INEEL EPA/ROD/R10-96/132, EPA/ROD/R10-96/147	• Reduced worker exposure in the short-term • Removal activities difficult to implement • Removal would entail significant expenditure of time/resources • Cost in comparison to competing alternative remedies • Leaving wastes in place represents best trade-off among alternatives
Maxey Flats EPA/ROD/R04-91/097	• Treatment of wastes impractical • Removal actions present significant risks to workers/environment • Excavation of wastes would not meet Commonwealth's requirements
Melton Valley Watershed DOE/OR/01-1826&D3	• Removal actions prohibitively expensive • Removal actions present unacceptable risks to workers • Removal actions present significant ecological risk
Moyer Landfill EPA/ROD/R03-85/018	• Remove/Dispose activities present air pollution hazards • Remove/Dispose activities will expose contaminants to the environment • Remove/Dispose activities present elevated risks to workers/community
Paducah Gaseous Diffusion Plant EPA/ROD/R04-95/235	• Removal actions present health/safety concerns • Removal actions present short-term risks to workers

Several of the reviewed Records of Decision indicate a preference for waste removal as the remedy of choice. These RODS, and the prevailing reasons behind the decision to remove/treat wastes, include:

Site	Reasons for removing waste
Hanford 300 Area EPA/ROD/R10-96/143	• Permanence of removal (as opposed to containment with millions of years of institutional controls) • Moves contaminants away from the Columbia River
Hanford 300 Area ROD not yet issued	• Long-term effectiveness/permanence of removal • Espoused preference for treatment (not addressed in other alternatives) • Desire to consolidate pre-1970 TRU waste in the 200 Area • Protection of direct exposure/groundwater/surface water pathways
FERNALD EPA/ROD/R05-95/286	• No non-removal alternatives were considered in the ROD – presumably non-removal alternatives were screened out prior to the writing of the ROD
FERNALD EPA/ROD/R05-95/289	• Concerns regarding the permanence of other remedial alternatives
Weldon Spring EPA/ROD/R07-90/043	• Implementation difficulties with non-removal alternatives • Suspect long-term permanence of non-removal alternatives
Weldon Spring EPA/ROD/R07-93-067	• Implementation difficulties with non-removal alternatives • Suspect long-term permanence of non-removal alternatives
Weldon Spring EPA/541/R-98/166	• Implementation difficulties with non-removal alternatives • Suspect long-term permanence of non-removal alternatives

Appendices

Appendix A – Downselected ROD Summary Information

Superfund Site	*ROD ID #*	State	Source Type	Contaminants	ROD Abstract	Remedy
Hanford	*EPA/541/R-95/126* **Interim action**	WA	Metal drums, debris, cardboard boxes, clothing, plastic	Strontium-90, methylene chloride, acetone, toluene, chromium, mercury, antimony, chrysene, pentachlorophenol, arsenic, lead, and zinc	Solid waste contaminated with radionuclides was buried in unlined trenches.	The major components of the selected remedial action include the removal of contaminated soils, structures, and debris using the observational approach and the plug-in approach; treatment by thermal desorption to remove organics and soil washing to reduce volume and to meet waste disposal criteria; disposal of contaminated materials at the Environmental Restoration Disposal Facility, backfill and vegetate excavated areas.
	EPA/541/R-97/044 **Interim action**	WA	Metal drums, debris, cardboard boxes, clothing, plastic	Strontium-90, methylene chloride, acetone, toluene, chromium, mercury, antimony, chrysene, pentachlorophenol, arsenic, lead, and zinc	Solid waste contaminated with radionuclides was buried in unlined trenches.	This amendment changes components of the selected remedy for the Hanford 100 Area radioactive liquid effluent disposal sites and clarifies the role of re-vegetation of remediated sites. The number of sites selected to receive the remedy of excavation, treatment, and on-site disposal has been changed from 37 to 71. In addition, the treatment step has been eliminated because it is not cost effective.
	EPA/ROD/R10-96/143 **Interim action**	WA	Solid and dilute liquid wastes	Trichloroethene, 1,2-dichloroethene, ammonia, arsenic, benzo(a)pyrene, cadmium, chrysene, PCBs, thallium, tetrachloroethene, cesium-137, chloroform, copper, and nickel	Past activities released hazardous and radioactive substances to the environment that contaminated soil, air, and groundwater.	The major components of the selected final remedy for 300-FF-1 include: removal of contaminated soil and debris; disposal of contaminated material at the Environmental Restoration Disposal Facility; re-contouring and backfilling of waste sites, followed by re-vegetation; and institutional controls to ensure that unanticipated changes in land use do not occur that could result in unacceptable exposures to residual contamination.

Superfund Site	*ROD ID #*	State	Source Type	Contaminants	ROD Abstract	Remedy
	EPA/541/R-99/112 **Interim action**	WA	Radionculides in hard waste	Carbon-14, Cesium-137, Cobalt-60, Europium-152, Europium-154, Nickel-63, Silver-108m, Strontium-90, and Tritium (H-3)	Radioactive material is believed to be contained in 27 of the 45 100-Area burial ground sites. Risks to human health, in the form of increased cancer risks, and risks to the area ecology are found though the soil, wind-blown dust, and external exposure to radiation.	The major components of the selected remedial action includes the removal of contaminated soils, irradiated reactor hardware and other solid wastes associated with reactor operations.
	300 Area ROD not yet issued	WA	Drummed/caissoned liquid and solid wastes	Pu fission products, other TRU constituents, Pu metal, Pu nitrate, organics and heavy metals	The foci of this summary are the 618-10 and 618-11 Burial Grounds, which operated between 1954 and 1967. The grounds were used to the disposal of pre-1970 transuranic-contaminated waste. This waste was placed in pipe units and trenches, and also in caissons in 618-11.	**Proposed remedy** is Remove-Treat-Dispose with institutional controls.
INEEL	*EPA/ROD/R10-93/070* **Interim action**	ID	Drums, cardboard boxes, and packaged waste	TRU radionuclides-plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, and americium (Am)-241,VOCs, other organics, and metals	The USDOE Idaho National Engineering Laboratory (Operable Unit 18) is part of the 890 square mile USDOE facility located in Idaho Falls, Idaho. The estimated capital cost for this interim remedy is $20,661,000, which includes an estimated total O&M cost of $29,102,000. Soil and debris cleanup goals are based on Federal and State standards.	The selected remedy for Pit 9 will use a combination of chemical extraction, physical separation, and stabilization technologies to recover contaminants and reduce the source of contamination.

Superfund Site	*ROD ID #*	State	Source Type	Contaminants	ROD Abstract	Remedy
	EPA/ROD/R 10-96/132 **Interim action**	ID	Debris, soil, and gravel located in a buried tank	Radionuclides, Cesium-137, Strontium-90, Uranium-234, -235, Cobalt-60, Europium-154, and Thorium-228, -230, -232	The Idaho National Engineering Laboratory (INEL) is a government facility managed by the U.S. Department of Energy (USDOE). At this time, the ground surface at the site looks very much like the surrounding terrain. Abundant native vegetation has grown over the mound and surrounding area. A large stake about 5 feet tall marks the reactor location. A chain link fence surrounds the burial ground. The contaminated surface soil area outside of the chain-link fence is bounded by a two-wire exclusion fence. The fences, posted with radiological control signs, and restricted access protect INEL workers and the public from unacceptable exposures.	The selected remedy includes: containment by capping with an engineered barrier constructed primarily of native materials; for BORAX-I, implementation will include consolidation of surrounding contaminated surface soils for containment under the engineered cover; contouring and grading of surrounding terrain to direct surface water runoff away from the caps.

Superfund Site	*ROD ID #*	State	Source Type	Contaminants	ROD Abstract	Remedy
	EPA/ROD/R 10-96/147 **Interim action**	ID	Debris, soil, and gravel located in a buried tank	Radionuclides, Cesium-137, Strontium-90, Uranium-234, -235, Cobalt-60, Europium-154, and Thorium-228, -230, -232	The BORAX-1 burial ground was established in 1954 and the SL-1 burial ground was established in 1961. In January, 1961, the SL-1 reactor was destroyed by an accidental nuclear excursion that resulted in a steam explosion. Very little contamination was released to the environment at the time of the accident due to the containment provided by the reactor building. Demolition and cleanup activities resulted in the spread of contamination over surface soils from Auxiliary Reactor Area II to the SL-1 burial ground. In 1954, the design mission of the BORAX-1 reactor was completed and the decision was made to conduct one final experiment that would result in the destruction of the reactor. The excursion contaminated approximately 84,000 square feet of ground. Following cleanup, the area was covered with soil.	The major components of the selected remedy include: containment by capping with an engineered barrier constructed primarily of native materials; for BORAX-1 implementation will include consolidation of surrounding contaminated surface soils for containment under the engineered cover.

Feed Materials Production Center	*EPA/ROD/R 05-95/286* **Final action**	OH	Solid, sludge and liquid	**Radionuclides, TRU:** Np-237, Pu-238, Pu-239/240	While in operation, the uranium ore processing facility provided high-purity uranium metal products in support of the nation's defense program. Operable Unit 1 is located within the Waste Storage Area, where wastes were generated during production.	Construction of waste processing and loading facilities and equipment; removal of water from open waste pits for treatment and the site's wastewater treatment facility; removal of waste pit contents, caps and liners, and excavation of surrounding contaminated soil.
	EPA/ROD/R 05-95/289 **Final action**	OH	Solid, liquid and sludge storage pits	Uranium-238, uranium-234, thorium-230, technetium-99 and strontium-90	During production, large quantities of liquid and solid waste materials were generated. Prior to 1984, liquid and solid materials from uranium processing were stored or disposed of in the on-site Waste Storage Area. This area, located west of the former production area, includes six low-level radioactive waste storage pits.	Excavation of all material with contaminants of concern above the established cleanup levels; material processing for size reduction and moisture control if required; on-site disposal in an engineered disposal facility with a composite cap and liner system; and off-site disposal of a small fraction of the excavated material that exceeds the waste acceptance criteria of the on-site disposal facility.
Maxey Flats Nuclear Disposal	*91/097* **Interim action**	KY	Solid and solidified-liquids, containerized and loose material	Pu-238, Pu-239/240, Am-241	4,750,000 cubic feet of low-level radioactive waste in a 45-acre area disposed of in unlined trenches, but concrete capped "Hot Wells" consisting of coated steel pipe, tile or concrete.	This final remedy substantially controls and reduces site risks to an acceptable level through treatment, engineering and institutional controls, and containment.
Melton Valley Watershed	01-1826 & D3 **Interim action**	TN	Solid and solidified-liquids, containerized and loose, containing radionuclides, organics, and inorganics	^{137}Cs, ^{60}Co, $^{239/240}$Pu, ^{241}Am, ^{244}Cm, ^{90}Sr, ^{3}H, As, Ba, Be, Cd, Cu, Tl, Zn, PCB-1260, Hg, Ni, Cr, Mo, and Se	The 1062 acres (430 ha) Melton Valley Watershed was a plutonium production site during World War II and a nuclear technology development site after the war. Three major World War II-era industrial research and production facilities were constructed as part of the Manhattan Project. From 1943 to 1986, the area was a major disposal site for wastes from over 50 off-site government-sponsored isotope users and buried in unlined trenches. Since 1988 silos, wells, trenches and aboveground tumuli have been used for disposal.	This interim remedy substantially controls and reduces site risks to an acceptable level through treatment, engineering and containment.

Moyer Landfill	*85/018* **Interim action**	PA	Containerized in drums and incinerated materials in bulk, containing radionuclides, organics, and inorganics in varying amounts.	Solid and liquid hazardous wastes, including polychlorinated biphenyls (PCBs), solvents, paints, and low-level radioactive wastes including traces of Radium-228, Strontium-90, and Technetium-99	According to local Federal Bureau of Investigation officials, the landfill, during its operation, accepted a variety of solid and liquid hazardous wastes, including polychlorinated biphenyls (PCBs), solvents, paints, low-level radioactive wastes, and incinerated materials in bulk form and/or containerized in drums.	The selected remedial action for this site includes interim soil clay capping, erosion and sedimentation control measures; surface water diversion; leachate collection, treatment and discharge; extraction, scrubbing and upgrading methane gas for delivery to the Philadelphia Electric Company (PECO); security/fencing measures; groundwater monitoring; institutional controls and all closure activities in compliance with RARA at the conclusion of the gas generation phase (10 to 20 years).
Paducah Gaseous Diffusion Plant	*EPA/ROD/R 04-95/235* **Interim action**	KY	Buried drums and uranium metal	Trichloroethene, arsenic, silver, manganese, vanadium, beryllium, uranium, and technetium-99	The C-749 Uranium Burial Ground is located in the west-central portion of the plant north of Virginia Avenue and on the western edge of the C-404 Low-Level Radioactive/Hazardous Burial Ground. It encompasses an area of approximately 2,970 square meters. The C-749 Uranium Burial Ground was used from approximately 1951 to 1970, for the disposal of uranium and uranium containing waste. The exact depth of the buried waste is not known. Wastes were reportedly placed in trenches and then covered with soil.	Once a determination has been made regarding the possible ground water interaction with the buried waste, a low permeability, multi-layered cap may be placed on SWMU 2, the C-749 Uranium Burial Ground, to reduce infiltration of surface water from precipitation events into and through buried wastes.

Weldon Spring	*90/043* **Interim action**	MO	Bulk wastes buried on the quarry grounds	Organics including PCBs and PAHs; radioactive materials; and metals including arsenic and lead.	The Weldon Spring site also contains a limestone quarry. The quarry covers an area of about 9 acres (3.6 ha). Prior to 1942, the quarry was mined for limestone that was used to support various construction activities in the area. The Army later used the quarry to dispose of the chemically contaminated materials from the ordnance works. The ordnance works was eventually closed and declared surplus to the Army's needs in 1946.	The interim remedial action for the site includes excavating an estimated 95,000 yd^3 of chemically and radioactively contaminated bulk wastes from the quarry and temporarily storing the wastes onsite in the chemical plant area.
	93/067 **Interim action**	MO	Four raffinate pits, Frog Pond, Ash Pond, and the north and south dump areas	PAHs and PCBs; metals, including arsenic, chromium, and lead; other inorganics, including asbestos; and radioactive materials.	The radioactive contaminants found at the site are primarily radionuclides of the natural uranium and Th-232 decay series. The chemical contaminants include naturally occurring metals and inorganic anions, as well as organic compounds such as polychlorinated biphenyls (PCBs) and nitroaromatic compounds.	883,000 yd^3 (675,000 m^3) of contaminated sludge, soil, sediment, structural material, vegetation, and process waste from the two water treatment plants would be removed from the source areas and on-site storage areas.
	98/166	MO	Groundwater, sediment, soil, and surface water at the Quarry proper, the Femme Osage Slough and nearby creeks; and quarry groundwater north of the Femme Osage Slough.	Inorganics, metals, nitroaromatics, PAHs, PCBs, and radioactive materials	The Department of Energy decided that no further remediation is necessary to protect human health and the environment at the Weldon Spring Site. They felt that previous remedial actions have removed the contaminants at the Weldon Spring Site and as a result no new migration of contaminants should reach the groundwater system. They decided to take this remedial action because there are still significant levels of uranium in quarry groundwater located north of the slough, which is in close proximity to the St. Charles County well field. This ROD allows the DOE to find an effective way to reduce or remove the uranium from the quarry groundwater so that it does not migrate towards the well field.	Implement a long-term groundwater monitoring strategy to verify the condition of the quarry area and St. Charles County. Also, implement controls to prevent uses of the site that would adversely affect contaminant migration.

Appendix B – Summaries of Excluded Records of Decisions

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
Lawrence Livermore Laboratory (USDOE)	*EPA/ROD/R09-92/081* **Interim remedial action**	CA	Buried	VOCs, other organics, metals, and radioactive materials	Vacuum induced treating, catalytic oxidation activated carbon pumping, and remediate the ground water plume using both existing and new extraction wells.	Focus was on the ground water and unsaturated sediments rather than landfill or buried contaminants.
	EPA/541/R-97/038	CA	Buried	Tetrachloroethylene, solvents, and petroleum	Vacuum induced treating, catalytic oxidation activated carbon pumping, and remediate the ground water plume using both existing and new extraction wells.	No evidence of radioactive contamination on site.
Fort Richardson (US Army)	*EPA/541/R-97/202* **Final action**	AK	Buried	VOCs, diesel-range organics, and gasoline-range organics	High-vacuum extraction, air-stripping system to treat extracted groundwater, institutional controls, natural attenuation, and long-term monitoring.	There were no radioactive waste or material listed or recorded on site.
	EPA/541/R-98/182	AK	Buried	Base neutral acids, inorganics, metals, Nitroaromatics, and PAH	Temporarily drain ponds, capping, and filling.	There were no radioactive waste or material listed or recorded on site.
Popile, Inc.	*EPA/ROD/R06-93/079* **Final action**	AR	Buried	VOCs and solvents	Remediation of shallow groundwater and contaminated soil. Treatment and engineering controls.	There were no radioactive waste or material listed or recorded on site.
Modesto Ground Water Contamination	*EPA/541/R-97/133* **Interim remedial action**	CA	Buried debris	Tetrachloroethene (PCE)	Groundwater extraction, treatment of Groundwater by air stripping, discharge of treated groundwater, soil vapors extraction, and institutional controls.	There were no radioactive waste or material listed or recorded on site. The primary contaminated medium is groundwater.
Travis Air Force Base	*EPA/541/R-98/029* **Interim remedial action**	CA	Buried	Base neutral acids, metals, PCBs, and VOCs	Interim remedial action, or combination of interim actions, appropriates to each site.	There were no radioactive waste or material listed or recorded on site. The primary contaminated medium is groundwater.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Halby Chemical Co.	*EPA/ROD/R03-91/115*	DE	Soil debris	VOCs, benzene, chromium, and metals	Consolidation of all debris, perform a soil grid sampling activity to determine the extent of remediation, perform a treatability study, long-term monitoring, and maintenance.	No evidence of radioactive contamination on site.
	EPA/541/R-98/014	DE	Buried	Inorganics, metals, and VOCs	Cover, excavate, backfill, and re-establish vegetation.	No evidence of radioactive contamination on site.
Florida Steel Corp.	*EPA/ROD/R04-92/122* **Interim remedial action**	FL	Buried and debris	Organics and metals	Excavating and disposing offsite soil and sediment contaminated with PCB levels equal to or greater than 50 mg/kg.	No evidence of radioactive contamination on site.
	EPA/ROD/R04-94/212 **Final action**	FL	Buried	Emission control dust, sodium, radium, and metals	Extracting groundwater contaminated with sodium and radium, blending it with clean water from an up-gradient portion of the site, and treating and disposing the blended water through land application on an up-gradient on-site spray field.	The primary contaminated medium is groundwater.
Jacksonville Naval Air Station	*EPA/ROD/R04-94/222* **Interim remedial action**	FL	Buried and groundwater	Pesticides and non-hazardous debris	Excavating and treating contaminated soil on-site, backfilling with treated soil, grading, and re-vegetating	Primary contaminants consisted of pesticides and non-hazardous debris.
	EPA/ROD/R04-94/229 **Interim remedial action**	FL	Buried and groundwater	Petroleum products, inorganic and organic materials, and asbestos	Construction and operation of a passive recovery system for LNAPL.	Primary contaminants consisted of petroleum products, inorganic and organic materials, and asbestos.
	EPA/ROD/R04-95/262	FL	Buried and surface water	Chromium, lead, cadmium, and pesticides	Site preparation and installation of the in situ mobile stabilization unit, berming and lining the area surrounding the pond perimeter to prevent pond overflow.	Primary contaminants consisted of chromium, lead, cadmium, pesticides, and other metals

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-98/022 **Final action**	FL	Buried and groundwater	Base neutral acids, metals, radioactive materials, and VOCs	Excavating and consolidating landfill, soil, and debris, and installation of a cover (cap) system over the landfill soil debris.	Primary contaminants consisted of base neutral acids, dioxins/dibenzofurans, metals and PCBs.
Agrico Chemical Co.	EPA/ROD/R04-92/123 **Final action**	FL	Buried	VOCs, other organics, metals, and radioactive materials	Excavating contaminated soil with concentrations above 1,463 mg/kg fluoride.	Main focus of ROD is on excavating soil with concentrations above 1,463 mg/kg fluoride.
	EPA/ROD/R04-94/204 **Final action**	FL	Groundwater and soil	Lead and fluoride	Monitoring of deep and shallow aquifer zones, installing two additional monitoring wells adjacent to the bayou.	Primary contaminants consisted of lead and fluoride. The primary contaminate medium is groundwater.
Stauffer Chemical Co. (Tarpon Springs)	EPA/541/R-98/103	FL	Buried, groundwater, and surface water	Metals, PAH, pesticides, radioactive, and VOCs	Excavation and consolidation of radiological, chemically contaminated material/soil in the main pond area.	The primary contaminated medium is groundwater.
Marine Corps Logistics Base	EPA/ROD/R04-92/107 **Interim remedial action**	GA	Landfill trenches	Organics, and metals	Covering with a multi-layer cap; excavating and disposing of sediment from within the catch basin.	No evidence of radioactive contamination on site.
	EPA/ROD/R04-94/197 **Interim remedial action**	GA	Landfill trenches	Solvents, paints, DDT, and PCBs	Groundwater extraction to control migration of the contaminant plume, on-site treatment of the extracted groundwater.	No evidence of radioactive contamination on site.
	EPA/ROD/R04-95/257	GA	Landfill trenches	Lead, PCBs, and PAHs	No remedy	No evidence of radioactive contamination on site.
	EPA/541/R-97/063	GA	Drum storage area	VOCs	Land-use restrictions with no further treatment, containment, or restricted access of the site.	No evidence of radioactive contamination on site.
	EPA/541/R-97/064	GA	Landfill	VOCs, barium, beryllium, cadmium, and cobalt	Land-use restrictions and institutional control plans (ICPs).	No evidence of radioactive contamination on site.
	EPA/541/R-98/082	GA	Trenches	Inorganics, metals, PAH, PCBs, pesticides, and VOCs	No Further Response Planned (NFRAP) decision be implemented. Land-use restrictions are implemented at potential source of contamination.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Eastern Michaud Flats Contamination	*EPA/541/R-98/034*	ID	Buried	Inorganics, metals, PAH, radioactive, and VOCs	Capping contaminated soils, extraction of contaminated groundwater, monitoring, and institutional controls.	The contaminated soils were located off site.
	R10-98/801	ID	Buried trenched	Metals, VOCs, and radionuclides	capping, extraction of contaminated soils and groundwater, monitoring and institutional controls	Traces of radioactive material could not be pin pointed to any specific location on site. What were found were very low levels, well below human health and safety levels.
Idaho National Engineering Lab (USDOE)	*EPA/ROD/R10-92/040* **Interim remedial action**	ID	Storage bunkers and soil	Organics and inorganics	Conducting soil sampling of the detonation areas, excavating, and transporting soil exceeding action levels offsite for treatment using incineration.	No evidence of radioactive contamination on site.
	EPA/ROD/R10-92/045 **Interim remedial action**	ID	Injection wells and groundwater	VOCs, metals, strontium and radioactive materials	Pumping the contaminated groundwater from the injection well and treating the ground water onsite. Also, air stripping and carbon adsorption to remove organics.	The primary contaminated medium is groundwater.
	EPA/ROD/R10-93/056	ID	Wastewater ponds and aquifers	Metals, other inorganics, and Radionuclides	No remedial action is necessary at the Test Reactor Area. The site poses no unacceptable risks to human health or the environment for expected current or future use. Groundwater monitoring will be conducted.	The primary contaminated medium is groundwater.
	EPA/ROD/R10-93/057	ID	Wastewater ponds and aquifers	Metals, other inorganics, and Radionuclides	No remedial action is necessary at the Test Reactor Area. The site poses no unacceptable risks to human health or the environment for expected current or future use. .Groundwater monitoring will be conducted.	The primary contaminated medium is groundwater.
	EPA/ROD/R10-93/058	ID	None	None	No contaminants of concern affecting this site.	No contaminants of concern affecting this site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R10-94/073	ID	Landfills	VOCs	Survey and mark the areas, restrict land use, monitor soil gases, and install and maintain a two-foot thick native soil cover over the landfill contents.	No evidence of radioactive contamination on site.
	EPA/ROD/R10-94/084	ID	Industrial waste ditch and landfill units	Chromium, mercury, cesium-137, cobalt-60, and barium	Survey and mark the areas, restrict land use, monitor soil gases, and install and maintain a two-foot thick native soil cover over the landfill contents. (presumptive remedy)	No evidence of radioactive contamination on site.
	EPA/ROD/R10-95/086	ID	Transuranic (TRU) storage area	Trichloroethylene and tetrachloroethylene	Installation and operation of five vapor extraction wells, and addition of soil vapor monitoring wells.	No evidence of radioactive contamination on site.
	EPA/ROD/R10-95/120	ID	Groundwater	Trichloroethene, tetrachoroethene, and struranium	Groundwater plume extraction and treatment of a heavily TCE-contaminated plume and hydraulic containment.	The primary contaminated medium is groundwater.
	EPA/541/R-98/060	ID	Warm waste ponds and landfill	Metals, PCBs, pesticides, petroleum, radioactive, and VOCs	A no further action decision with no source present or a source present that represents an acceptable risk for unrestricted use.	A no further action decision with no source present or a source present that represents an acceptable risk for unrestricted use.
	EPA/541/R-98/061	ID	Storage and disposal areas	Metals, PCBs, pesticides, petroleum, and VOCs	Monitoring of the soil, groundwater, and vegetation will continue for 20 years.	No evidence of radioactive contamination on site.
Monsanto Chemical Co. (Soda Springs)	EPA/541/R-97/049	ID	Ore and slag piles and solid waste landfill	Arsenic, beryllium, cadmium, radium, thorium, and uranium	Institutional controls or excavation of contaminated soils and replacement with clean soil. The remedy is no further action.	The remedy is no further action.
Iowa Army Ammunition Plant	EPA/541/R-98/167	IA	On-site lagoons and impoundment	Metals, Nitroaromatics, PAH, and PCBs	Biological treatment and solidification and stabilization with Activated Carbon treatments.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-98/168 **Interim remedial action**	IA	On-site lagoons and impoundment	Metals, Nitroaromatics, PAH, and PCBs	Excavation of soils, verification sampling, restoration of excavated areas to original conditions, and temporary storage of the most highly contaminated soils in the on-site corrective action management unit.	No evidence of radioactive contamination on site.
Seymour Recycling Corp.	EPA/ROD/R05-86/046	IA	Drums and bulk tanks	Heavy metals, and VOCs	Contaminated groundwater will be extracted from the shallow aquifer and treated.	No evidence of radioactive contamination on site.
	EPA/ROD/R05-87/050	IA	Drums and bulk tanks	Inorganics, organics, and VOCs	Deed and access restrictions, institutional controls, and soil vapor extraction.	No evidence of radioactive contamination on site.
H and K Sales	EPA/541/R-98/158 **Final action**	MI	Wooden crates	Radium-painted gauges	Removed all radioactive material off-site and disposed of the material in appropriate regulated facilities.	No additional response activities are necessary to address this Superfund site.
Albion-Sheridan Township Landfill	EPA/ROD/R05-95/275	MI	Drums and landfill	Metals and VOCs	Removal and off-site treatment and disposal of drums.	No evidence of radioactive contamination on site.
Newsom Brothers/Old Reichhold Chemicals	EPA/ROD/R04-89/050 **Final action**	MS	Buried drums	VOCs, benzene, toluene, and metals	Waste and contaminated soils removed from site.	No evidence of radioactive contamination on site.
	EPA/541/R-97/188	MS	Underground storage tanks	Sodium sulfite, oils, diesel oil, boron trifluoride, and phenol	Contaminated soils and sediments were removed, with no current on-site exposure.	No evidence of radioactive contamination on site.
Anaconda Co. Smelter	EPA/ROD/R08-88/018 **Interim remedial action**	MT	Debris and soil	Metals and arsenic	Contaminated debris from the relocation or demolition activities will be consolidated and temporarily stored with similar debris.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-91/053	MT	Debris and soil	Metals, arsenic, cadmium, and lead	Removal and treatment via on-site cement/silicate based stabilization.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R08-94/083 **Final action**	MT	Waste piles	Arsenic and heavy metals	Constructing engineering covers and/or re-vegetating over waste material in recreational and potential commercial/industrial areas, upgrading or repairing levees to contain the 100-year peak flood event and prevent erosion of waste materials.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/127	MT	Railroad beds and soils	Arsenic and lead	Removal and replacement with clean soil/vegetative or other protective barrier, clean up of all future residential soils at the time of development, and implementation of institutional controls.	No evidence of radioactive contamination on site.
	EPA/541/R-98/096 **Final action**	MT	Debris and soil	Inorganics, and metals	Reduction of arsenic concentrations, reclamation of the soils and waste area, removal of waste material followed by soil cover, and re-vegetating.	No evidence of radioactive contamination on site.
Weldon Spring Quarry (USDOE)	*EPA/ROD/R07-90/043* **Interim remedial action**	MO	Building debris and quarry	Organics, radioactive materials, metals, arsenic, and lead	Remove and transport bulk waste from the quarry.	No evidence of significant levels of radioactive contamination on site. Remedy dealt primarily with the non-radioactive elements.
	EPA/ROD/R07-93/067 **Interim remedial action**	MO	Raffinate pits	Organics, metals, inorganics, and radioactive materials	Constructing a new sludge processing facility, a volume reduction facility, and an engineered disposal facility onsite.	No evidence of significant levels of radioactive contamination on site. Remedy dealt primarily with the non-radioactive elements.
	EPA/R07-96/087	MO	Landfill	Metals, radioactive materials, thorium 230, and radon 222	Clearing and grubbing to access the contaminated areas and pipeline, excavation and transportation of contaminated soils and debris.	No evidence of significant levels of radioactive contamination on site. Remedy dealt primarily with the non-radioactive elements.
	EPA/541/R-98/166	MO	Quarry	Organics, metals, inorganics, and radioactive materials	Long-term groundwater monitoring strategy and institutional controls.	No evidence of significant levels of radioactive contamination on site. Remedy dealt primarily with the non-radioactive elements.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
St Louis Airport Coatings Co.	*EPA/541/R-98/169* **Final action**	MO	Buried and groundwater	Base neutral acids, inorganics, metals, and radioactive elements	Excavation and off-site disposal of contaminated soil.	No evidence of significant levels of radioactive contamination on site. Remedy dealt primarily with the non-radioactive elements.
General Electric Co./Shepherd Farm	*EPA/ROD/R04-95/255*	NC	Underground Storage Tanks (USTs) and groundwater	Solvents, transformer oil, and paint sludge	Extraction of groundwater sub-sites that are contaminated above maximum contaminant levels. Onsite treatment of the extracted groundwater via air stripping and carbon adsorption.	No evidence of radioactive contamination on site.
Davis Park Road TCE	*EPA/541/R-98/055*	NC	USTs	Inorganics, metals, PCBs, pesticides, and VOCs	Contaminated aquifer will be restored to the lower of either the maximum contaminant level.	No evidence of radioactive contamination on site.
Pease Air Force Base	*EPA/ROD/R01-93/083*	NH	Landfill	VOCs, other organics, and metals	Excavation and consolidation and construction of a cap over. Extraction and treatment of groundwater to facilitate excavation of saturated landfill debris.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-93/085	NH	Ditches	VOCs, other organics, and metals	Excavation of contaminated soils and drainage piping. Groundwater extraction and treatment for excavation de-watering purposes.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-94/093	NH	Soil borrow	VOCs	Soil vapor extraction (SVE) treatment of source area soil contaminated above cleanup goals and treatment of extracted soil vapor for removal of volatile organic compounds.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-94/094	NH	Soil borrow	JP-4 fuel, oils, solvents, and construction wastes	No further action because the Baseline Risk Assessment has shown that risk-based levels are not exceeded and the site poses no unacceptable risk to human health and the environment.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-95/103	NH	Groundwater	Polynuclear aromatic hydrocarbons (PAHs), arsenic, cadmium, and metals	In situ vapor extraction treatment of contaminated vadose zone soil, installation of a low-permeability membrane on the ground surface in the source area.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R01-95/104	NH	Landfill and rubble	Benzene, chlorobenzene, vinyl chloride, and methylene chloride	Excavation of contaminated landfill soil and solid waste.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-95/109	NH	UST	VOCs, metals, trichloroethane, and TCE	Installation of a vertical barrier to facilitate containment, extraction and treatment of groundwater from within and below the vertical barrier to prevent migration of contaminants and excavation and off-site disposal.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-95/110	NH	Buried and Groundwater	Dioxins, lead, benzene, toluene, ethyl benzene, xylenes, and aromatic hydrocarbons	Enhancement of SVE by air sparring and long-term monitoring of groundwater.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-95/111	NH	Landfill	Metals, phthalates, phenols, diesel fuel, and benzoic acid	The placement of deed restrictions on the use of groundwater, Groundwater Management Zone (GMZ), and no further action under CERCLA is planned.	No evidence of radioactive contamination on site.
	EPA/541/R-97/163	NH	Ditches	Fuels, oils, solvents, lubricants, protective coatings, and paints	Removing contaminated sediments, treated and/or disposed of off base at an asphalt batching facility.	No evidence of radioactive contamination on site.
NI Industries	EPA/ROD/R02-91/162	NJ	Buried sediment debris	Metals, arsenic, chromium, and lead	Solidification/stabilization and on-site placement of the slag and lead oxide piles, decontamination and off-site treatment and disposal of debris, and contaminated surfaces.	No evidence of radioactive contamination on site.
	EPA/ROD/R02-94/228 **Final action**	NJ	Landfill	Lead, cadmium, antimony, and ferrous sulfate	Excavating all soils contaminated, treating via solidification/stabilization of those soils classified as hazardous under RCRA, and disposing the treated soils along with the non-hazardous soils in a landfill to be constructed on the site.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Woodland Route 72 Dump	*EPA/ROD/R02-90/101* **Interim remedial action**	NJ	Buried drums	Benzene, toluene, uranium, thorium series, and lead	Excavation and off-site disposal.	Remedy dealt primarily with the non-radioactive elements.
	EPA/ROD/R02-93/222 **Final action**	NJ	None	None	The New Jersey Department of Environmental Protection and Energy has selected no further action for the second operable unit.	No further action is needed, not applicable to study.
	EPA/ROD/R02-93/223 **Final action**	NJ	None	None	The New Jersey Department of Environmental Protection and Energy has selected no further action for the second operable unit.	No further action is needed, not applicable to study.
Woodland Route 532 Dump	*EPA/ROD/R02-90/102* **Interim remedial action**	NJ	Buried	Benzene, pesticides, uranium, thorium series, lead, and chromium	Excavation and off-site disposal.	Remedy dealt primarily with the non-radioactive elements.
United Nuclear Corp.	*EPA/ROD/R06-88/044*	NM	Groundwater and tailing piles	Metals and radioactive materials	Contain, remove, and evaporate contaminated groundwater resulting from tailing seepage outside the tailing disposal area.	The primary contaminated medium is groundwater.
Radium Chemical Co., Inc.	*EPA/ROD/R02-90/103* **Final remedy**	NY	Abandoned lead containers and drums	Radioactive materials, radium 226, decay products, and radon gas	Partial decontamination, complete dismantling of the building, and clean material in an approved sanitary landfill. Excavation and disposal of any contaminated material.	Radioactive material was removed from the site.
Wright-Patterson Air Force Base	*EPA/541/R-98/105*	OH	Landfills	Pesticides, petroleum hydrocarbon, radioactive, and VOCs	No action as the remedial alternative.	No action as the remedial alternative.
	EPA/541/R-97/112	OH	Landfills and drums	Benzene, toluene, and beryllium	In-situ bio-degradation of contaminants in subsurface soil, natural attenuation of contaminants in groundwater, operation and maintenance of existing recovery systems, institutional controls, and subsurface soil and groundwater monitoring.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R05-93/245 **Interim remedial action**	OH	Landfills	VOCs, other organics, metals, and inorganics	Low permeability clay cap, leachate collection and treatment. Landfill gas collection and treatment. Public water supply for private well users, performance monitoring. Disposal of non-hazardous drills cuttings under the clay cap.	No evidence of radioactive contamination on site.
	EPA/ROD/R05-94/262	OH	Landfills	Barium, arsenic, and benzene	Low permeability clay cap, leachate collection and treatment. Landfill gas collection and treatment. Public water supply for private well users, performance monitoring. Disposal of non-hazardous drills cuttings under the clay cap.	No evidence of radioactive contamination on site.
	EPA/ROD/R05-96/309	OH	Landfills	Metals	Institutional controls and access and deed restrictions.	No evidence of radioactive contamination on site.
Teledyne Wah Chang Albany (TWCA)	*EPA/ROD/R10-90/021* **Interim remedial action**	OR	Lakes and groundwater	Organics, metals, chromium, zirconium, lead, and radioactive materials	Digging up, solidifying and removing the sludge.	The primary contaminated medium is groundwater.
	EPA/ROD/R10-94/078 **Final action**	OR	Sludge ponds and groundwater	PCBs, methy isobutyl, and ketone	Extracting groundwater, and treating via air stripping or liquid-phase carbon adsorption, discharging treated groundwater to TWA's wastewater treatment plant, implementing deed restrictions and institutional control on land and groundwater use, preventing slope erosion of contaminated fill with a geotextile cover and riprap.	No evidence of radioactive contamination. The primary contaminated medium is groundwater.
Moyers Landfill	*EPA/ROD/R03-85/018* **Interim remedial action**	PA	Landfill	Arsenic, heavy metals, radioactive material, and VOCs	Gas venting, gas monitoring, surface water collection and discharge, leachate collection and treatment, operation and maintenance.	The primary contaminated medium is groundwater.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Metropolitan Mirror And Glass	*EPA/541/R-98/064*	PA	Drainage ditches, lagoons, and groundwater	Base neutral acids, inorganics, metals, radioactive materials, and VOCs	"No action"	"No action"
Lansdowne Radiation Site	*EPA/ROD/R03-85/014*	PA	Dwellings	Other radionuclides, radium, and radon	Permanent relocation of the residents. No operation and maintenance associated with this action.	The primary contaminated medium is the dwellings.
	EPA/ROD/R03-86/027	PA	Dwellings	Actinium, protactinium, radium, and thorium	All radioactive material above established permissible levels will be packed and sealed in approved containers, and disposed of at an approved offsite disposal facility.	The primary contaminated medium is the dwellings.
Austin Avenue Radiation Site	*EPA/ROD/R03-94/181* **Final action**	PA	Residential structures	Radioactive contamination	Removing contaminated components from the residential structures. Removing and disposing of radiation-contaminated soils and waste at off-site permitted facilities.	The primary contaminated medium is the residential structure.
	R07-96/087	PA	Landfill debris	PCBs and lead	Treatment and containment technologies for remediation of soil and pipeline media. Excavation of contaminated soils and debris.	No evidence of radioactive contamination on site.
	EPA/ROD/R03-96/238	PA	Buildings	Radium, thorium, and uranium	Removing contaminated components from the residential structures. Removing and disposing of radiation-contaminated soils and waste at off-site permitted facilities.	The primary contaminated medium is the dwellings.
Jacks Creek/Siskin Smelting and Refinery	*EPA/541/R-97/087* **Final action**	PA	Waste piles and lagoons	Copper, lead, selenium, silver, and zinc	Excavation of soils and treatment at an off-site hazardous waste treatment facility, on-site consolidation of waste piles materials, vacuum dredging and consolidation of sediments, and covering and capping of the consolidated soils.	No evidence of radioactive contamination on site.
Ohio River Park	*EPA/ROD/R03-93/164*	PA	None	None	No action with respect to the soil contamination.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R03-96/227	PA	Landfill and buried	Herbicides (2,4-D, 2,4,5-TP, Dioxin), PCBs, and phenolic compounds	Capping of concentrated waste areas with a multi layer cap, surface water control systems, and installing a passive gas collection system.	No evidence of radioactive contamination on site.
	EPA/541/R-98/046	PA	Trenches and surface piles	Base neutral acids, in-organics, metals, pesticides, radioactive, and VOCs	Natural attenuation processes shall be allowed to reduce the concentrations. Monitoring of groundwater.	Very low levels of radioactive elements were detected on site. The primary contaminates of concern were the acids, metals, and pesticides.
Naval Air Development Center	*EPA/ROD/R03-93/175* **Interim remedial action**	PA	Landfill and trenches	VOCs and metals	Installation, operation, and maintenance of groundwater extraction wells such as precipitation, filtration, air stripping, and carbon adsorption. Offsite treatment and disposal of solid residuals.	No evidence of radioactive contamination on site.
	EPA/ROD/R03-95/218	PA	Landfill and trenches	Acetone, arsenic, beryllium, and PCBs	Installation, operation, and maintenance of groundwater extraction wells such as precipitation, filtration, air stripping, and carbon adsorption. Offsite treatment and disposal of solid residuals.	No evidence of radioactive contamination on site.
	EPA/541/R-97/178 **Interim remedial action**	PA	Landfill and trenches	Trichloroethylene agents	Installation, operation, and maintenance of groundwater extraction wells such as precipitation, filtration, air stripping, and carbon adsorption. Offsite treatment and disposal of solid residuals.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Modern Sanitation Landfill	*EPA/ROD/R03-91/138* **Final action**	PA	Landfill	VOCs, benzene, toluene, and metals	Continued operation and maintenance of all previous remedial actions conducted onsite including the landfill cap, groundwater extraction system, onsite wastewater treatment facility, gas extraction system (for removal and destruction of landfill generated methane gas), and groundwater and surface water monitoring.	No evidence of radioactive contamination on site.
Vega Alta Public Supply Wells	*EPA/ROD/R02-87/050*	PR	Wells and groundwater	PCE, TCE, and VOCs	Treatment of groundwater.	Remedy deals exclusively with groundwater.
	EPA/541/R-97/192 **Interim remedial action**	PR	Buries	Trichloroethene and perchloroethene	Operation of a SVE unit, implementation of a system monitoring program, and appropriate environmental monitoring.	No evidence of radioactive contamination on site.
Milan Army Ammunition Plant	*EPA/ROD/R04-92/126* **Interim remedial action**	TN	Ponds and groundwater	VOCs, other organics, and inorganics	Pumping and pretreatment of contaminated groundwater immediately down gradient of the former O-line ponds.	Remedy deals exclusively with groundwater. No evidence of radioactive contamination on site.
	EPA/ROD/R04-93/160	TN	Drainage ditches and groundwater	Organics and metals	Extension of the existing multi-media cap to cover contaminated soil.	No evidence of radioactive contamination on site.
	EPA/ROD/R04-94/199	TN	Ponds and groundwater	Explosives and inorganics	Removing and treating contaminated groundwater from the aquifer using extraction wells, on-site filtration to remove suspended solids and associated inorganic constituents, and granular activated carbon to remove the explosives compounds and discharging treated groundwater.	Remedy deals exclusively with groundwater. No evidence of radioactive contamination on site.
	EPA/ROD/R04-96/241	TN	Landfill	Explosives	Excavated soil will be treated using a bioremediation process to reduce the concentrations of explosive compounds.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-98/020 **Final action**	TN	Landfill and burrow pits	Inorganics, metals, nitroaromatics, and VOCs	No further action is the selected remedy for soil and groundwater.	No further action is the selected remedy for soil and groundwater. No evidence of radioactive contamination on site.
Monticello Mill Tailings (USDOE)	*EPA/541/R-98/106* **Interim remedial action**	UT	Groundwater	Inorganics, metals, and radioactive elements	Mill site de-watering and treatment, monitoring, and permeable reactive treatment wall installation.	Remedy deals exclusively with groundwater.
Hanford 200- Area (USDOE)	*EPA/ROD/R10-95/100*	WA	Soils	Radioactive, hazardous waste, asbestos, PCBs, mixed waste radio nuclides, heavy metals, and VOCs	This ROD addresses the disposal of radioactive, hazardous/dangerous, asbestos, PCB, and mixed waste resulting from the remediation of operable units within the 100, 200, and 300 Area National Priorities List (NPL) sites of the Hanford Site. The ERDF will minimize migration of contaminants from waste, primarily soils debris, placed in the facility. The 1100 Area ROD, issued in September 1993, specifies that the waste generated during remediation will be disposed of off site.	
	EPA/ROD/R10-95/114 **Interim remedial action**	WA	Groundwater	Carbon tetrachloride, plutonium, chloroform, and TCE	Removing and treating contaminated groundwater from the aquifer using extraction wells. On-site filtration to remove suspended solids and associated inorganic constituents. Granular activated carbon to remove the explosive compounds and discharging treated groundwater.	Remedy deals exclusively with groundwater. No evidence of radioactive contamination on site.
	EPA/541/R-97/048	WA	Groundwater	Uranium, technetium-99, and nitrate,	Pumping the highest concentration zone of the contaminated groundwater.	Remedy deals exclusively with groundwater.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-97/101 **Interim remedial action**	WA	Landfill	Radioactive elements, hazardous waste, asbestos, and heavy metals	Construction and operation of two disposal cells. During excavation suitable soils will be stockpiled and modified closure cover over the waste.	Radioactive elements were only suspected to be on site. Primary focus was on heavy metals and hazardous wastes.
Hanford 1100- Area (USDOE)	EPA/ROD/R10-93/063 **Final action**	WA	Buried	VOCs, other organics, metals, and inorganics	Capping and offsite disposal and incineration.	No evidence of radioactive contamination on site.
Savannah river site (USDOE)	EPA/ROD/R04-92/109 **Interim remedial action**	SC	Drainage ditches and buried	VOCs, metals, and acids	Excavating and compacting the process sewer line and associated soil and sediment. Installing a low permeability cap. Sampling the accumulated rainwater in the basin and treatment. Maintaining the cap, monitoring ground water, and implementing institutional controls.	No evidence of radioactive contamination on site.
	EPA/541/R-97/204	SC	Soil and Groundwater	Americium, antimony, cesium, cobalt, curium, europium, plutonium, potassium, strontium, uranium, and aluminum	This remedy addresses contamination in the L-Area Oil and Chemical Basin (LAOCB) and L-Area Acid/Caustic Basin (LAACB) within the Savannah River Site. The remedy for LAOCB is in-situ stabilization and disposal in the LAOCB for cleanup of the LAOCB pipeline, and in-situ stabilization and capping of the LAOCB for cleanup of the LAOCB soil. The remedy for the LAACB is no further action.	Not landfill waste
	EPA/ROD/R04-92/110 **Interim remedial action**	SC	Underground sewerage line	VOCs	Installing 11 ground water recovery wells under the RCRA program. Extracting and treating contaminated groundwater using an air stripper. Onsite discharge to an NPDES permitted outfall. Upgrading the air-stripping tower to include an off-gas treatment system based on the result of a treatability study.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R04-93/163 **Final action**	SC	None	None	No further action is necessary for the unit.	EPA investigations indicate that the previous RCRA closure of the site has reduced the threat to human health and the environment sufficiently therefore, there are no contaminants of concern affecting this site.
	EPA/ROD/R04-93/164 **Final action**	SC	None	None	No further action is necessary for the unit.	EPA investigations indicate that the previous RCRA closure of the site has reduced the threat to human health and the environment sufficiently therefore, there are no contaminants of concern affecting this site.
	EPA/ROD/R04-94/187 **Final action**	SC	Buried trenches	Barium, chloroform, cadmium, and uranium	The closure activities involved the neutralization of waste from a pH of 13.2 to a pH of less than 12.5, removal of as much waste as reasonably possible, and shipment of the waste to an on-site storage/ disposal facility. All remaining waste and the tank void were stabilized in place with concrete.	No further action since previous action was taken under a RCRA closure plan, per Settlement Agreement 90-64-SW (September 5, 1990) USDOE, Savannah River Site.
	EPA/ROD/R04-95/202 **Interim remedial action**	SC	Unlined earthen basins	TCE, PCE, nitrate, mercury, gross alpha, lead, and chromium	Establishment of a hybrid groundwater corrective action, stabilizing the portion of the plume contaminated with TCE. Air strippers, air emissions and the re-circulation well will be used to monitor the performance of the interim action.	Interim action focused primarily on the clean up of TCE in the groundwater and in the air.
	EPA/ROD/R04-95/215 **Interim remedial action**	SC	Pre-cooler ponds and canals	Cesium-137	Refilling and maintaining Par Pond to its original level following repair of the Par Pond Dam. Maintenance of the reservoir until a (NEPA) evaluation can be accomplished.	Radioactive elements consisted of leaks and purges into the ponds and groundwater and were not stored in any systematic fashion.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R04-95/218 **Interim remedial action**	SC	Trenches and drums	Metals, VOCs, SVOCs, and dioxins	Removal and management of buried drum contents, discernible layers of sludge present within the basin, and replacement of excavated soils.	No Radionuclides were disposed of within the trenches.
	EPA/ROD/R04-95/224	SC	Groundwater	Tritium, alpha and beta emitting Radionuclides, and metals	Groundwater Operable Unit requires no further action under CERCLA. RCRA permit provides for the recovery of contaminated groundwater via extraction wells and treatment of hazardous constituents and Radionuclides (except tritium and nitrates).	Remedy deals exclusively with groundwater.
	EPA/ROD/R04-95/225	SC	Groundwater	Radionuclides	The remedy described in the 1992 SRS RCRA permit provides for recovery of contaminated groundwater via extraction wells and treatment of hazardous constituents and Radionuclides (except tritium and nitrates). The treated water under the conditions of the current permit will be injected into the shallow aquifer.	Remedy deals exclusively with groundwater.
	EPA/ROD/R04-96/268 **Final action**	SC	Earthen pits	Arsenic	No action is needed for the BRRP unit soils. Only non-hazardous, inert material was placed at the BRRP source unit. A notation, identifying the presence of buried, inert debris, on the deed to the facility property will be placed in the Aiken county records.	No evidence of radioactive contamination on site.
	EPA/541/R-97/025	SC	Soil and Groundwater	Cesium -137 and radium -233	This remedy addresses contamination at the Silverton Road Waste Unit (SRWU) at Savannah River Site. The selected remedy for soil is institutional controls. The remedy for the "M Area" groundwater aquifer is no further action with monitoring.	Groundwater-related remedy.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-97/022	SC	Burning/rubble pits	Tritium, plutonium, cesium-137, strontium-90, iodine-129, uranium-238, radium-226, and potassium-4	Signs will be posted at the source unit, which indicate that this area was used for the disposal of waste material and contains buried waste. SRS access controls and notification disclosing former waste management and disposal activities taken on the site.	No known or suspected radioactive material were allowed in the burning pits. These radioactive waste were managed in the Radioactive Waste Burial Ground. Large volumes of uncontaminated construction debris disposed in the pits may have included relatively small non-homogeneously distributed amounts of low level contamination by cesium-137, strontium-90, and iodine-129.
	EPA/541/R-97/023	SC	Buried	Arsenic, chromium, and lead	The results of an investigation at the site revealed that the Gunsite 113 Access Road Unit poses no risk to human health or the environment; therefore, no further action has been selected for the site.	No evidence of radioactive contamination on site.
	EPA/541/R-97/024 **Final action**	SC	Rubble pits	Tritium, plutonium, nuclear materials, chemical wastes, and radioactive wastes	Gunsite 720 Rubble Pit Unit poses no risk to human health or the environment; therefore, no action is needed at the Gunsite 720 Rubble Pit Unit.	There is no evidence of any burning or excavation at this waste unit. No contamination, other than household trash (bottles, wrappers, etc.), was noted in the area.
	EPA/541/R-97/026	SC	Debris above ground	Hydrocarbons, and chlorinated hydrocarbons	The selected remedy for this site is no action.	The selected remedy for this site is no action. No evidence of radioactive contamination on site.
	EPA/541/R-97/027	SC	Waste pits	Chemical wastes, radioactive wastes, tritium, plutonium, oil, degreasers, spent organic solvents, and radioactive materials	Institutional controls, restricting this land to future industrial use and groundwater monitoring.	Radioactive elements were removed from the site completely.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-97/205	SC	Drainage basins	Tritium, plutonium, and nuclear materials	Restrict this land to future industrial use and limit access to the soil, which might expose future workers to low concentrations of hazardous constituents through use of administrative controls such as site use and site clearance permits. Groundwater monitoring.	Remedy deals primarily with groundwater.
	EPA/541/R-97/207	SC	Buried waste	PCBs, plastics, degreasers, rubber, and organic solvents	The selected remedy for BRP6G is no action. The South Carolina Department of Health and Environmental control has modified the SRS RCRA permit to incorporate the selected remedy.	The selected remedy for BRP6G is no action. The South Carolina Department of Health and Environmental control has modified the SRS RCRA permit to incorporate the selected remedy.
	EPA/541/R-98/021	SC	Buried pits and debris	Inorganics, metals, PAH, and radioactive materials	Restrict this land to future industrial use and limit access to the soil, which might expose future workers to low concentrations of hazardous constituents through use of administrative controls such as site use and site clearance permits. Groundwater monitoring.	The ROD focused primarily on the inorganics, metals, and non radioactive materials.
	EPA/541/R-98/059	SC	Settling basins and burning pits	Base neutral acids, inorganics, metals, PAH, and VOCs	No action; the previous soil removal activities conducted outside of CERCLA at the FDHTF has eliminated the need to perform additional remedial action.	No action and no evidence of radioactive contamination on site.
	EPA/541/R-98/071	SC	Building construction	Dioxins/Dibenzofurans, inorganics, metals, PAH, PCBs, petroleum hydrocarbon, radioactive, and VOCs	No action. Either there was no significant discharge of hazardous material to the seepage basin or natural remediation processes (i.e., bioremediation) have reduced the levels of hazardous material to the extent that they no longer pose risk to human health or the environment.	No action and no radioactive material were known to have been discharged to the HWMF.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-98/114	SC	Building construction	Base neutral acids, inorganics, metals, PAH, PCBs, pesticides, petroleum hydrocarbon, and VOCs	No further action, since remedial action objectives (RAOs) have been achieved by the interim remedial action (IRA) and biovent testing. The selected remedy for shallow soil, surface water, and sediment is no action, because no chemicals of concern were identified for them in the Baseline Risk Assessment.	No evidence of radioactive contamination on site. No radioactive material were known to have been discharged to the HWMF.
	EPA/ROD/R04-92/108 **Interim remedial action**	SC	Soil and sludge	Radioactive materials	The selected remedial action for this site includes pumping and onsite treatment of any standing water that remained in the basin; excavating, dewatering, and stabilizing approximately 37,000 cubic yards of basin sludge using Portland cement; placing, consolidating, and compacting the stabilized sludge into the basin.	Material not landfill or buried.
	EPA/541/R-98/187	SC	Drainage basin	PAH and radioactive materials	No further action with confirmatory groundwater monitoring at the site.	No radioactive material were known to have been discharged to the HWMF.
47) Alabama Army Ammunition Plant	EPA/ROD/R04-92/102 **Final action**	AL	Stockpiled soil	Explosives, metals, and inorganics	Separating contaminated soil and incinerating onsite contaminated soil. Testing the treated soil for explosives and lead to verify compliance with the treatment criteria.	No evidence of radioactive contamination on site.
	EPA/ROD/R04-94/184 **Interim remedial action**	AL	Stockpiled soil	Lead, chromium, and arsenic	Separating contaminated soil and incinerating onsite contaminated soil. Testing the treated soil for explosives and lead to verify compliance with the treatment criteria.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R04-95/251 **Final action**	AL	Underground industrial sewer lines	Explosive compounds, asbestos, and lead	Perform soil and sediment sampling and analysis; excavate soils in contaminated areas; screen materials; transport material to the transportable incineration system site; and treat material by incineration or stabilization until treatment and disposal criteria are satisfied.	No evidence of radioactive contamination on site.
	EPA/541/R-97/020 **Interim remedial action**	AL	Landfill	Metals, asbestos, explosive compounds, TNT, arsenic, and barium	Perform soil and sediment sampling and analysis; excavate soils in contaminated areas; screen materials; transport material to the transportable incineration system site; and treat material by incineration or stabilization until treatment and disposal criteria are satisfied.	No evidence of radioactive contamination on site.
Interstate Lead Co. (ILCO)	EPA/ROD/R04-91/090 **Final action**	AL	Debris	Metals, arsenic, chromium, and lead	Replacing the treated soil, solidification of battery casing material, re-vegetating of excavated areas, and semi-annual sampling and analysis of existing monitor wells.	No evidence of radioactive contamination on site.
	EPA/ROD/R04-95/192	AL	Landfill	Arsenic, beryllium benzene, cadmium cobalt, and manganese	Conduct a site-specific field-scale treatability study to determine the effectiveness of the acid leaching process and excavate the contaminated soil.	No evidence of radioactive contamination on site.
	EPA/ROD/R04-95/243	Al	Landfill	Lead, aluminum, arsenic, barium, beryllium, cadmium, copper, lead, manganese, and mercury	Natural attenuation (e.g., dilution, flushing, burial, etc.) of the contaminated sediment.	No evidence of radioactive contamination on site.
Denver Radium Site	EPA/ROD/R08-86/004	CO	Asphalt	Radium	Excavation and disposal with the modified no action alternative. This remedy entails leaving the contaminated material in place.	Radioactive material was contained in the asphalt.
	EPA/ROD/R08-86/009	CO	Debris soils	Radium	Full removal and permanent off-site disposal.	Contaminant was removed from the site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R08-87/012 **Interim remedial action**	CO	Building debris	Radium	Storage of the contaminated material within reinforced synthetic.	Radioactive material was contained in the building debris.
	EPA/ROD/R08-87/013	CO	Air and debris soil	Radium	Maintaining the cap and temporary storage facility until a facility suitable for the permanent disposal of the Denver Radium site waste becomes available, and final removal of the contaminated material to the permanent disposal facility.	Focus of radioactive elements was on air concentrations.
	EPA/ROD/R08-87/014	CO	Air and debris soil	Radium	Maintaining the cap and temporary storage facility until a facility suitable for the permanent disposal of the Denver Radium site waste becomes available, and final removal of the contaminated material to the permanent disposal facility.	Focus of radioactive elements was on air concentrations.
	EPA/ROD/R08-87/015	CO	Air and debris soil	Radium and radon gas	Excavating the contaminated soil from the open areas and from under the buildings, maintaining the concrete cap, and maintaining the temporary land-storage facility.	Focus of radioactive elements was on air concentrations and building debris.
	EPA/ROD/R08-87/017 **Interim remedial action**	CO	Air and debris soil	Radioactive materials and radium	Excavating the contaminated soil from the open areas and from under the buildings, maintaining the concrete cap, and maintaining the temporary land-storage facility.	Focus of radioactive elements was on air concentrations and building debris.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R08-92/062	CO	Landfill	Metals	Multi-media cap over on-site contaminated soil;, providing inspection and repair of the concrete floor, as necessary; upgrading the asphalt with geotextile fabric. Long-term monitoring to ensure effectiveness of the cap and implementing institutional controls.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-92/063 **Final action**	CO	Buried debris	Metals, inorganics, and radioactive materials	Demolishing and decontaminating buildings, tanks, and equipment on-site; temporarily storing debris; placing a cap over the stabilized material, and re-vegetating the area.	Focus of radioactive elements was on building debris.
Aberdeen Proving Ground (Michaelsville)	EPA/ROD/R03-91/126	MD	Buried	None	The no action decision is based upon the fact that the supposed white phosphorus contamination at the site was never found using current available technology.	No evidence of radioactive contamination on site.
	EPA/ROD/R03-92/162	MD	Landfill	VOCs, other organics, and metals	The selected remedial action for this site includes replacing the existing cover with a multi-layer cap in accordance with state requirements for sanitary landfills.	No evidence of radioactive contamination on site.
	EPA/541/R-97/092	MD	Buried	Pesticides, paint, asbestos, solvents, and motor oil	The selected remedy at this site is no further action. Monitoring to verify that no unacceptable exposures to potential hazards posed by conditions at MLF Operable Unit 2 (OU 2) will occur in the future.	No evidence of radioactive contamination on site.
Firestone Tire and Rubber Co (Salinas Plant)	EPA/ROD/R09-89/039 **Final action**	CA	Groundwater	Benzene, toluene, and xylenes	The final remedy provides for cleanup and cleanup requirements for groundwater under the site and extending to a distance of over 2 miles from the site.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Air Force Plant #4 (General Dynamics)	*EPA/ROD/R06-96/105*	TX	Landfill	VOCs	No action is the selected remedy for soil at Landfill No. 4 and Landfill No. 3 and for sediments in Meandering Road Creek.	No evidence of radioactive contamination on site.
McClellan Air Force Base (GW CONTAM)	*EPA/ROD/R09-93/104* **Interim remedial action**	CA	Landfill	VOCs, other organics, and metals	No remedy listed	No evidence of radioactive contamination on site. No remedy listed.
	EPA/ROD/R09-95/136 **Interim remedial action**	CA	Landfill	VOCs, TCE, CIS-1, 2-DCE, PCE, 1, 2-DCA	This groundwater OU remedy is designed to prevent the spread of contamination that is already in the groundwater.	No evidence of radioactive contamination on site.
Moffet Naval Air Station	*EPA/ROD/R09-95/131*	CA	Landfill	VOCs, SVOCs, PCBs, total petroleum hydrocarbons, and inorganic constituents	No action was the selected remedy for the following sites at OU2-east	No evidence of radioactive contamination on site.
	EPA/541/R-97/129	CA	Landfill	Waste oils, jet fuels, solvents, cleaners, and washing compounds	The selected response action addresses the principal threat posed by the site through consolidation and contaminant of wastes.	No evidence of radioactive contamination on site.
Solvent Savers	*EPA/ROD/R02-90/111*	NY	Buried	VOCs, PCE, TCE, other organics, PAHs, and PCBs	Excavation and removal of an estimated 300 buried drums for off-site treatment and disposal at an approved RCRA hazardous waste facility;	No evidence of radioactive contamination on site.
E H Schilling Landfill	*EPA/ROD/R05-89/099*	OH	Buried	VOCS, benzene, PAHS, pesticides, phenol, and arsenic	A containment with treatment option has been chosen and will require long term management.	No evidence of radioactive contamination on site.
Ellisville Site	*EPA/ROD/R07-85/004* **Interim remedial action**	MO	Buried	Flammable gelatinous materials, oils, pesticides, phenols, sludge, solvents, and toluene	Remedial action should be implemented for the Jean Ellen Callahan property to control erosion and slippage of the fill area where drums were excavated during the 1981-82 immediate removal action.	No evidence of radioactive contamination on site.
	EPA/ROD/R07-86/006 **Interim remedial action**	MO	Buried	Dioxin and organics	Excavation and containerization in semi-bulk sacks of 2,3,7,8-tcdd.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R07-91/056	MO	Buried	Dioxin	Excavation and interim, onsite storage of 2,3,7,8-tetrachlorodibenzo-p-dioxin (dioxin-) contaminated material at the site	No evidence of radioactive contamination on site.
Ellsworth Air Force Base	*EPA/ROD/R08-95/108* **Interim remedial action**	SD	Buried	JP-4 jet fuel, benzene, toluene, ethylbenzene, xylene, chlorinated and VOCs	The selected interim remedial action for soil and groundwater contamination cleanup consists of: SVE groundwater removal by wells and an existing interceptor trench; treatment of soil gas condense and groundwater; and surface discharge of treatment effluent.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-95/109 **Interim remedial action**	SD	Buried	VOCs, pesticides, JP-4 jet fuel, benzene, toluene, xylene, and TCE	The selected interim action remedy for groundwater contamination cleanup consists of: groundwater removal using wells, treatment of groundwater, and surface of discharge of treatment effluent.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/114	SD	Buried	PAHs, pesticides, VOCS, SVOCs, TCE, jet fuel, and other inorganic and organic compounds	The selected alternative, capping, includes the following major components: placing a soil cover, capable of sustaining perennial vegetation, over the landfill area; modification of storm water discharge point and drainage; institutional controls for the landfill area; long-term groundwater, surface water, and sediment monitoring; and long-term maintenance of soil cover.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R08-96/116	SD	Buried	Petroleum hydrocarbons	The selected remedy for OU 10 is no action. Media affected solely by petroleum hydrocarbon contamination will be addressed through State of South Dakota programs for underground storage tank removal and petroleum contaminated soils. Groundwater cleanup will be addressed as part of the base wide groundwater OU 11.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/117 **Interim remedial action**	SD	Buried	Benzene, toluene, ethylbenzene, xylene, PAHs, and jet fuel	The selected alternative for OU-9 is no action. Media affected solely by petroleum hydrocarbon contamination will be addressed through State of South Dakota programs for underground storage tank removal and petroleum-contaminated soils. Groundwater cleanup and the fish-ingestion exposure pathway will be addressed as part of the groundwater OU 11.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/118 **Interim remedial action**	SD	Buried	VOCS, SVOCs, phthalates, jet fuel, benzene, ethylbenzene, cyanide, thallium, mercury, and arsenic	The selected alternative is source area soil and groundwater treatment.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/119	SD	Buried	VOCS, SVOCs, TPHs, pesticides, inorganics, sediment, arsenic, and beryllium	constructing an earth cover, capable of sustaining perennial vegetation, over those areas of the landfill that are not adequately covered	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R08-96/120	SD	Buried	tetrachloroethylene (PCE), toluene, xylenes, benzene, and TCE	The selected alternative, capping, includes the following major components: placing a soil cover, capable of sustaining perennial vegetation, over the landfill area; a pre-design study to examine the need for landfill gas control measures; institutional controls for the landfill area; long-term groundwater monitoring; and long-term maintenance of soil cover.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/121 **Interim remedial action**	SD	Landfill	VOCs, PAHs, jet fuel, pesticides, PCBs, analytes, dioxin/furan, and organics	The selected alternative remedy for the landfill is soil cover.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/122	SD	Landfill	Tetrachloroethane (TCA), methylene chloride, and dichloroethene	The selected alternative is a soil cover. The major components are: placing a soil cover capable of sustaining perennial vegetation over the landfill area; institutional controls for the landfill area; long-term groundwater monitoring; and long-term maintenance of the soil cover.	No evidence of radioactive contamination on site.
	EPA/ROD/R08-96/124	SD	Buried	VOCs, toluene, SVOCs, bis(2-ethylhexyl)phthalate, PAHS, jet fuel, TPHs, pesticides, and inorganics	The selected remedy for Area 1 includes the following components: constructing an earth cover over a portion of the EOD area. The selected alternative for Area 2 includes the following: constructing an earth cover over the debris burial area.	No evidence of radioactive contamination on site.
	EPA/541/R-97/111	SD	Groundwater	Petroleum	On-base containment of groundwater containing contaminants at unsafe concentrations. Institutional controls and long-term monitoring.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
Mather Air Force Base	*EPA/ROD/R09-94/107* **Final action**	CA	Groundwater	TCE	The selected remedial action, Alternative 3b, which provides the best route towards achieving the cleanup standards and restoring the groundwater to full beneficial use.	No evidence of radioactive contamination on site.
	EPA/ROD/R09-95/140	CA	Buried	VOCs and TCE	Excavation and consolidation.	No evidence of radioactive contamination on site.
	EPA/ROD/R09-96/149	CA	Buried	Diesel, gasoline, aluminum, chromium, lead, and manganese	Treating contaminated soil sites	No evidence of radioactive contamination on site.
	EPA/541/R-98/084	CA	Buried	Metals, oil and grease, organics, PAH, petroleum hydrocarbon, and VOCs	Installing an in situ SVE system comprised of extraction wells and possibly passive injection wells. Treatment of off gas by granular activated carbon or more cost-effective means of best available control technology.	No evidence of radioactive contamination on site.
Pepper Steel and Alloys, Inc.	*EPA/ROD/R04-86/008*	FL	Buried	Arsenic, chromium, heavy metals, organics, and PCBs	Collection of all free oil and disposal offsite according to TSCA regulations. Excavation of soils exceeding 1 ppm PCB, 1,000 ppm lead and 5 ppm arsenic.	No evidence of radioactive contamination on site.
Powell Road Landfill	*EPA/ROD/R05-93/244* **Final action**	OH	Mixed waste	VOCs, other organics, and metals	The remedial action will be a final site-wide remedy. The selected remedial action addresses the sources of the contamination by containment of the landfill and contaminated soils and treatment of leachate and ground water.	No evidence of radioactive contamination on site.
Coakley Landfill	*EPA/ROD/R01-90/047*	OH	Groundwater	VOCs, benzene, PCE, other organics, phenols, metals, arsenic, and chromium	Protect the drinking water aquifer by minimizing further migration of contaminants to the groundwater and surface water, and will eliminate threats posed by direct contact with or ingestion of contaminated soils and waste at the site.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R01-94/090	OH	Groundwater	VOCS, chloroethane, 1,1-dichloroethane, chlorobenzene, ethyl benzene, and benzene	The selected remedial action for this site includes using institutional controls (such as deed restrictions) to prevent use of contaminated groundwater; using natural attenuation for the contaminated groundwater plume; and groundwater monitoring.	No evidence of radioactive contamination on site.
Love Canal	*EPA/ROD/R02-85/014*	NY	Sewers	Chlorides, chlorobenzenes, and sulfides	Five areas have been defined for remediation under this recommended action.	No evidence of radioactive contamination on site.
	EPA/ROD/R02-88/055	NY	Sewers	Dioxin	Destruction/disposal of dioxin-contaminated sewer and creek sediments.	No evidence of radioactive contamination on site.
	EPA/ROD/R02-91/165 **Final action**	NY	Sewers	VOCs, toluene, xylenes, other organics, PAHs, pesticides, metals, arsenic, chromium, and lead	Excavation and off-site disposal of approximately 7000 cubic yards of the contaminated material from the hot-spot areas, which may be reused or recycled off-site as cover or fill material.	No evidence of radioactive contamination on site.
Lee's Lane Landfill	*EPA/ROD/R04-86/017*	KY	Buried	Chromium, heavy metals, inorganics, and VOCs	Institutional controls, which will be fully identified during remedial design, will be implemented.	No evidence of radioactive contamination on site.
United Nuclear Corp.	*EPA/ROD/R06-88/044*	NM	Groundwater	Metals	Contain, remove, and evaporate contaminated groundwater resulting from tailing seepage outside the tailing disposal area thus preventing further migration of seepage into the environment.	No evidence of radioactive contamination on site.
Newmark Groundwater Contamination	*EPA/ROD/R09-93/097* **Interim remedial action**	CA	Groundwater	VOCs	No remedy listed.	No evidence of radioactive contamination on site. No remedy listed.
	EPA/ROD/R09-95/133 **Interim remedial action**	CA	Groundwater	PCE, TCE, and VOCs	EPA has selected an interim remedy for the Muscoy plume of groundwater contamination in the Newmark Groundwater Contamination Superfund Site. This portion of the site cleanup is referred to as the Muscoy Plume OU.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Lackawanna Refuse	*EPA/ROD/R03-85/010*	PA	Buried drums	Organic acids, paints and thinners, sludge, toxic metal, and various solvents	Removal of all drums and highly contaminated municipal refuse from pit 5 for off-site disposal at a qualifying RCRA facility	No evidence of radioactive contamination on site.
Naval Surface Warfare (Dahlgren Site)	*EPA/541/R-97/179* **Interim remedial action**	VA	Landfill	Antimony, arsenic, beryllium, chromium, copper, lead, manganese, nickel, and vanadium	The selected remedy for Site 2 involves the removal of soils exceeding cleanup goals; removal of the western and southern trenches and debris piles; backfilling with clean fill; consolidating all removed waste on site; recycling recyclable material from debris piles off site; capping the fenced area and consolidated waste and soils; and providing institutional controls to limit the site to future industrial use and to exclude shallow groundwater use. Surface water and groundwater shall continue to be monitored.	No evidence of radioactive contamination on site.
Industri-Plex	*EPA/ROD/R01-86/020*	MA	Groundwater	Benzene, heavy metals, toluene, and VOCs	None available	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
New London Submarine Base	*EPA/ROD/R01-95/108*	CT	Landfill and groundwater	Toluene, ethylbenzene, xylene, DDT, DDD, DDE, and metals	Capping of the site with a multi-layer cap; landfill gas control to manage landfill gas migration; surface controls to minimize erosion and manage runoff; use of fencing and institutional controls to control site access and future site use; provisions for conducting additional studies.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
	EPA/541/R-97/162	CT	Groundwater	None listed	No further action is necessary to protect human health and the environment.	No further action is necessary to protect human health and the environment.
	EPA/541/R-98/002 **Interim remedial action**	CT	Landfill and groundwater	Metals, oil and grease, pesticides, and VOCs	Capping, institutional controls, and groundwater monitoring.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-98/003	CT	Groundwater	Metals, oil and grease, pesticides, and VOCs	Removal, on-site treatment, and discharge of standing water from ponds and streams with appropriate stream flow diversions; clearing/grubbing of contaminated soil areas; dredging, on-site dewatering and off-site disposal of contaminated sediment; excavation, on-site dewatering and off-site disposal of contaminated soil; and placement of clean soil backfill	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
	EPA/541/R-98/128	CT	Soil	None listed	No further action is necessary to protect human health and the environment	No further action is necessary to protect human health and the environment.
Fort Devens	EPA/ROD/R01-95/112	MA	Soils and groundwater	VOCs	Excavating the surface soil , stockpiling soils for sampling and analysis, cold mixing asphalt batch soils exceeding site cleanup levels of 7 ppm.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-95/113	MA	Landfill and groundwater	Arsenic and chromium	Completing closure of Shepley's Hill Landfill in accordance with applicable Massachusetts requirements. Monitoring and evaluating the effectiveness of the landfill cover system completed in 1993 at controlling groundwater contamination and site risk.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
	EPA/ROD/R01-96/119	MA	Groundwater	Metals, organics, petroleum hydrocarbons, and explosives	No action is the selected remedy for SPIA monitored-area groundwater, Area 41 groundwater, and the surface water.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
	EPA/541/R-97/158	MA	Groundwater	Petroleum, oils, lubricants, benzene, toluene, and VOCs	Capping, institutional controls, and groundwater monitoring.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-97/159	MA	Buried and groundwater	Petroleum Hydrocarbon compounds (TPHCs), and VOCs	The Army's selected remedy at AOC 63 AX is no further action. AOC 63AX poses no unacceptable risks to human health or the environment.	No evidence of radioactive contamination on site.
	EPA/541/R-98/001	MA	Air, and groundwater	Pesticides, petroleum hydrocarbon, and VOCs	Remedial actions address long-term worker exposure to contaminated soil and the potential consumption of groundwater.	No evidence of radioactive contamination on site.
MaterialTechnology Laboratory	EPA/ROD/R01-96/124	MA	Buried	SVOCs, PAHs, PCBs, lead, pesticides, and fuel	This remedy addresses long-term residential and commercial exposure to contaminated soil. It consists of excavating the contaminated soils and transporting the soil for off-site disposal or reuse.	No evidence of radioactive contamination on site.
	EPA/ROD/R01-96/128	MA	Buried	PAH and pesticides	Excavating the contaminated soil and shipping it to an approved landfill or soil recycling operation in accordance with applicable Massachusetts requirements.	No evidence of radioactive contamination on site.
Lone Pine Landfill	EPA/ROD/R02-84/007	NJ	Landfill	Metals, pesticides, resins, solvents, and VOCs	Installation of a shallow groundwater cut-off wall and surface seal over the landfill; groundwater collection wells; and treatment of the groundwater collected from within the groundwater cut-off wall.	No evidence of radioactive contamination on site.
	EPA/ROD/R02-90/106	NJ	Landfill and groundwater	VOCs, benzene, PCE, phenols, TCE, toluene, xylenes, metals, arsenic, chromium, and lead	A landfill containment system including a cap, slurry wall, and leachate collection/treatment.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Chemical Control	*EPA/ROD/R02-87/041*	NJ	River sediments	Metals, organics, pesticides, and VOCs	Removal of debris remaining from earlier response actions, including drill cuttings, monitoring well development water, items recovered from the Elizabeth River under the initial remedial measure, used disposable equipment, and the decontamination pad.	No evidence of radioactive contamination on site.
South Brunswick Landfill	*EPA/ROD/R02-87/052*	NJ	None listed	None listed	On-site containment and monitoring for a period of thirty (30) years. A post remedial monitoring plan has been proposed to assess the long term integrity of the remedy and evaluate any previous off-site migration of contaminants in the context of chemical specific and ambient areas.	No evidence of radioactive contamination on site.
Nascolite Corp.	*EPA/ROD/R02-88/059*	NJ	Tanks and groundwater	Organics and VOCs	Focuses on ground water contamination in the aquifer underlying the site.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
	EPA/ROD/R02-91/145	NJ	Ditches	VOCs, benzene, PCE, TCE, toluene, xylenes, metals, and lead	Structure demolition, excavation and solidification/stabilization of unsaturated wetlands, replacement of solidified soils on the site; restoration of affected wetlands; and appropriate environmental monitoring to ensure the effectiveness of the remedy.	No evidence of radioactive contamination on site.
Clothier Disposal	*EPA/ROD/R02-89/077*	NY	Landfill and drums	Metals, VOCs, PCBs, organics, and phenols	Removal of drums	EPA has determined that risk levels associated with this residual contamination are minimal and within the range considered acceptable in Superfund remedies.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Curcio Scrap Metal, Inc.	*EPA/ROD/R02-91/143* **Final action**	NJ	Buried	PCBs, metals, and lead	Excavation of soil contaminated with PCBs and heavy metals above applicable cleanup standard and transportation of the excavated soil to an appropriate incineration facility for treatment or disposal.	No evidence of radioactive contamination on site.
	EPA/541/R-97/107	NJ	Groundwater	VOCs and metals	No further action is needed at the Curcio Scrap Metal, Inc. site. The removal of contaminated material by the potentially responsible parties in 1994 was successful in cleaning up the principal threats associated with the site.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
Lodi Municipal Well	*EPA/ROD/R02-93/221*	NJ	None listed	None listed	No further activities are planned for the site.	A no action response has been selected for the Lodi Municipal Well site. The radionuclides found in the ground water at the well have been determined to be naturally occurring and, therefore, cannot be addressed under CERCLA.
Shieldalloy Corp.	*EPA/ROD/R02-96/283*	NJ	Groundwater	Aluminum, antimony, arsenic, barium, beryllium, and cadmium	Pump-and-treat actions and long-term operation and maintenance until cleanup levels are achieved.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
Malta Rocket Fuel Area	*EPA/ROD/R02-96/274*	NY	Groundwater and drinking water	PCBs, VOCs, lead, and mercury	Pumping of the test station water supply wells and treatment of the water by air stripping to provide an acceptable drinking water supply for the employees. Continued monitoring of the influent and effluent of the air stripper requirements.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
William Dick Lagoons	*EPA/ROD/R03-91/137* **Interim remedial action**	PA	Groundwater	VOCs, benzene, PCE, TCE, organics, phenol, and metals	Groundwater extraction wells will be installed at and surrounding the site. Groundwater will be pumped to a treatment plant constructed to remove site-related contaminants. The actual treatment components of the plant will be determined during the initial phases of this remedy.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
	EPA/ROD/R03-93/177 **Interim remedial action**	PA	Lagoons	VOCs, other organics, and metals	Reduce the concentrations of hazardous substances in the site soils so that leaching of contaminants into the groundwater will be minimized.	No evidence of radioactive contamination on site.
Aladdin Plating	*EPA/ROD/R03-88/062*	PA	Groundwater	Arsenic, chromium, and lead	Reduce the concentrations of hazardous substances in the site soils so that leaching of contaminants into the groundwater will be minimized.	No evidence of radioactive contamination on site.
	EPA/ROD/R03-94/179 **Final action**	PA	Groundwater	Chromium	Implementing institutional controls prohibiting well-drilling in the shallow water-bearing zone beneath the site and excavating within the entire 6-acre parcel. Collecting and analyzing groundwater samples from monitoring and residential wells for thirty years.	No evidence of radioactive contamination on site.
Lee's Lane Landfill	*EPA/ROD/R04-86/017*	KY	Landfill and groundwater	Chromium, heavy metals, inorganics, and VOCs	Provision for a properly operating gas collection system, consideration of a possible future alternate water supply, cleanup of surface waste area, bank protection controls, establishment of an ACL for the groundwater at the site.	No evidence of radioactive contamination on site.
Geiger and M Oil)	*EPA/ROD/R04-87/020*	SC	Groundwater	Arsenic, and heavy metals	Extraction of contaminated groundwater. On-site treatment of extracted groundwater. Discharge of treated groundwater to off-site stream.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R04-93/156	SC	Buried	VOCs, other organics, and metals	Soils will be treated in situ using solidification / stabilization; contaminated groundwater will be extracted, treated onsite, and disposed of either on-site or off-site.	No evidence of radioactive contamination on site.
	EPA/541/R-98/087	SC	Groundwater	Metals	Extraction of contaminated groundwater. Onsite treatment of extracted groundwater. Discharge of treated groundwater to off-site stream.	No evidence of radioactive contamination on site. Remedy deals primarily with groundwater.
Cape Fear Wood Preserving	EPA/ROD/R04-89/048	NC	Drainage ditch	VOCs, metals, benzene, and organics	Extraction of contaminated groundwater. Onsite treatment of extracted groundwater. Discharge of treated groundwater to off-site stream.	No evidence of radioactive contamination on site.
El Toro Marine Corps Air Station	EPA/541/R-97/135	CA	Groundwater and soil	VOCs, waste oils, paint residues, hydraulic fluid, used batteries, semi-volatile organic compounds (SVOCs), petroleum hydrocarbons, pesticides, and metals	The selected remedy is no further action, because the Navy has determined that the existing condition of the sites is protective of human health and the environment.	No evidence of radioactive contamination on site.
	EPA/541/R-97/136	CA	Groundwater and soil	VOCs, waste oils, paint residues, hydraulic fluid, used batteries, SVOCs, petroleum hydrocarbons, pesticides, and metals	The selected remedy is no further action, because the Navy has determined that the existing condition of the sites is protective of human health and the environment.	No evidence of radioactive contamination on site.
Fields Brook	EPA/ROD/R05-86/035	OH	Landfill	Arsenic, base-neutral compounds, metals, chromium, mercury, and VOCs	Temporary storage and dewatering; the thermal treatment of a portion; the solidification and land filling.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-97/115	OH	Landfill	Chlorinated solvents, and PCBs	Excavation of soils; backfilling with clean soil; on-site containment of remaining soils with a cover and erosion blanket; disposal of soils at either an on-site or off-site TSCA landfill; removal of sediment and debris from inside sewer lines and associated catch basins.	No evidence of radioactive contamination on site.
Pristine, Inc.	EPA/ROD/R05-88/060 **Final action**	OH	Drums	Benzene, inorganics, metals, organics, and VOCs	Excavation and onsite consolidation and extraction of groundwater.	No evidence of radioactive contamination on site.
Forest Waste Products	EPA/ROD/R05-88/062 **Final action**	MI	Landfill, drums, and groundwater	Metals, arsenic, lead, and organics	Removal and offsite treatment of areas of concentrated drums and associated saturated contaminated soils. Installation of a RCRA cap over the landfill.	No evidence of radioactive contamination on site.
Long Prairie Ground Water Contamination	EPA/ROD/R05-88/066 **Final action**	MN	Groundwater	VOCs (DCE, PCE, TCE)	Install ground water extraction wells in the contamination plume; treat contaminated ground water with an air stripper; discharge treated ground water from the air stripper to the long prairie river; and treat contaminated soil with an active soil venting system.	No evidence of radioactive contamination on site.
Allied Chemical and Ironton Coke	EPA/ROD/R05-88/078 **Final action**	OH	Groundwater	Inorganics, cyanide, metals, organics, PAHs, phenols, VOCs, and benzene	Construction of a low permeability slurry wall around the disposal area; installation of a multi-media RCRA-compliant cap, and extraction and on-site treatment of contaminated groundwater.	No evidence of radioactive contamination on site.
Northernaire Plating	EPA/ROD/R05-89/114 **Final action**	MI	Groundwater	VOCs	Construction of a low permeability slurry wall around the disposal area; installation of a multi-media RCRA-compliant cap, and extraction and on-site treatment of contaminated groundwater.	No evidence of radioactive contamination on site.

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Springfield Township Dump	*EPA/ROD/R05-90/143* **Final action**	MI	Landfill	VOCs, PCB, metals, and lead	Excavation and thermal destruction of soils; solidification of incinerator ash; and installation of an in-situ vacuum extraction system.	No evidence of radioactive contamination on site.
Skinner Landfill	*EPA/ROD/R05-93/225* **Final action**	OH	Landfill	VOCs, other organics, metals, and inorganics	Construction of a RCRA cap over the waste materials; interception, collection, and treatment of contaminated groundwater; diversion of upgradient groundwater flow; monitoring; institutional controls; and soil vapor extraction.	No evidence of radioactive contamination on site.
Petoskey Municipal Well Field	*EPA/ROD/R05-95/274* **Interim remedial action**	MI	Groundwater	Arsenic, cis-1,2-dichloroethene, and VOCs	On-line treatment of groundwater from the Ingalls Avenue Municipal Well. Air stripping has been identified as the appropriate treatment technology to address the levels and types of contamination seen to date in groundwater and near the well.	No evidence of radioactive contamination on site.
Parsons Casket Hardware Co.	*EPA/ROD/R05-96/307*	IL	Buried	VOCs, SVOCs, metals	Security fence around the site; deed/zoning restrictions to prohibit groundwater use, limit building construction on the site, and control waste material generated from manipulation of soils at the site.	No evidence of radioactive contamination on site.
Homestake Mining Co.	*EPA/ROD/R06-89/050*	NM	None listed	None listed	No action remedy.	No action remedy. No evidence of radioactive contamination on site.
Crystal Chemical Co.	*EPA/ROD/R06-90/062*	TX	Drums	Arsenic and metals	Install a multi-layer cap over the entire site; pump ground water from contaminated acquirers and treat the groundwater onsite by chemical precipitation, filtration, and ion exchange; discharge treated water to publicly owned treatment works.	No evidence of radioactive contamination on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
Eagle Mine	*EPA/ROD/R08-93/068* **Interim remedial action**	CO	Groundwater	VOCs	Install a multi-layer cap over the entire site; pump ground water from contaminated acquirers and treat the groundwater onsite by chemical precipitation, filtration, and ion exchange; discharge treated water to publicly owned treatment works.	No evidence of radioactive contamination on site.
Sharon Steel Corp. (Midvale Tailings)	*EPA/ROD/R08-94/082* **Interim remedial action**	UT	Groundwater	Lead, cadmium, and arsenic	Dredging of the wetlands to remove contaminated sediments. Construction of a five-foot, multi-layer, vegetated soil cap (or design-based equivalent) over the entire tailings and soil pile.	No evidence of radioactive contamination on site
Lowry Landfill	*EPA/ROD/R08-94/087*	CO	Soils	Low-level radioactive medical wastes, VOCs, and various landfill wastes	A groundwater collection system was installed to treat approximately 6.4 million gallons of contaminated groundwater annually. A landfill gas collection using interior and perimeter collection system was established. A perimeter gas monitoring system was installed to detect potential landfill gas migration. The final component was to implement institutional controls to limit access to the Lowry Site.	Primary radioactive waste was medical waste at very low quantities and levels.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
Glen Ridge Radium	*EPA/ROD/R02-89/079* **Interim remedial action**	NJ	Soils and debris	Radium 226	Remedial action provides a permanent solution for many of the residential properties, including those with the most extensive contamination. This action also provides an interim solution for a number of contaminated properties, where radon gas and indoor gamma radiation levels exceed health guidelines.	Not applicable to study.
	EPA/ROD/R02-90/125 **Final action**	NJ		Radioactive material, radium 226, and lead	The selected interim remedial action for this site includes excavating and disposing of 323,000 cubic yards of contaminated soil and other radium-contaminated material from residential and public properties, followed by disposing of the soil off-site	Not applicable to study.
Montclair Radium	EPA/ROD/R02-89/080 **Interim remedial action**	NJ	Soils and debris	Radium 226	The remedial action presented in this document represents the first planned for the site. It provides a permanent solution for many of the residential properties, including those with the most extensive contamination. This action also provides an interim solution for a number of contaminated properties where radon gas and indoor gamma radiation levels exceed health guidelines.	Not applicable to study.
	EPA/ROD/R02-90/126 **Final action**	NJ	Soils and debris	Radioactive materials, radium 226, metals, and lead	The selected remedial action for this site includes excavating 323,000 cubic yards of contaminated soil (including glen ridge radium site soil, which will be remediated concurrently).	Not applicable to study.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
U.S. Radium Corp.	*EPA/ROD/R02-93/207* **Final action**	NJ	Soils	Radium 226	The remedy described in this document represents the first operable unit for the U.S. Radium Corporation site. It addresses the principal threats to human health and the environment associated with the residential properties in the vicinity properties study area and the satellite properties study area, as well as certain commercial properties in those study areas, and is the final remedial action for those properties.	Not applicable to study.
	EPA/ROD/R02-95/253	NJ	Soils	Radionuclides, radium-236, thorium, uranium, and lead	The major components of the selected remedy for the second operable unit include excavation/removal of the radium-contaminated material above remedial action objectives from the designated properties; and off-site disposal of the radium-conta effectiveness of the remedy.	Not applicable to study.
Teledyne Wah Chang Site	*EPA/ROD/R10-95/125* **Interim remedial action**	OR	Soils	Radionuclides, thorium, radium-226, PCBs, and HCBs	The selected remedy combines source remediation with institutional controls to reduce risks to human health and environment posed by contaminants in surface and subsurface soil at the TWCA site.	Not applicable to study.
Monticello Mill Tailings (USDOE)	*EPA/ROD/R08-90/034* **Final action**	UT	Soil and debris	Radioactive material, radium 226, and lead	The remedy addresses the principal threats at the site which are associated with radon emissions and direct exposure to gamma radiation from the existing mill tailings piles.	Not applicable to study.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
Monticello Radioactive Contaminated Prop.	*EPA/ROD/R08-89/025*	UT	Construction material, and mill tailings	Radium 226, radon 226, and uranium	In consultation with EPA and the state, DOE developed a remedial action plan to stabilize and control uranium mill tailings and related contaminated material at the Monticello vicinity properties in a long-term manner that complies with EPA's standards for remedial action at inactive uranium processing sites (40 cfr part 192).	No further action is needed, not applicable to study.
Loring Air Force Base	*EPA/ROD/R01-95/105*	ME	Soil, sediment, and groundwater	Uranium, radio nucleotides, tritium, VOCs, and VOCs	It has been determined that no action is necessary to address the contamination of OU 1 soils, surface water, sediments, and groundwater. Previous response actions relating to radionuclides at OU 1 have eliminated the need to conduct a remedial action. OU 1 inorganic groundwater contamination will be addressed in a separate ROD, and the petroleum contamination at Area G will be addressed separately under the Maine underground storage tank regulations.	The ROD abstract was not clear whether or not there was radioactive material currently on the site.
Ellsworth Air Force Base	*EPA/ROD/R08-96/123*	SD	Soil and groundwater	Low-level radioactive waste	The major components are institutional controls for future land use and an extensive record search to be performed that may provide additional information relating to the burial trenches. A removal action might be used to address waste within the trenches if the weight of evidence from this records search, combined with previous information, identifies and warrants this type of remedial activity.	The ROD abstract was not clear whether or not there was radioactive material currently on site.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
Brookhaven National Laboratory (USDOE)	*EPA/ROD/R02-96/285*	NY	Landfill, underground storage	Radionuclides	Treatment of chemically contaminated soil using a soil vapor extraction system, fencing, monitoring, and treatment of groundwater.	Radioactive material was cleaned up.
E.I. DU Pont De Nemours (Newport Landfill)	*EPA/ROD/R03-93/170* **Final action**	DE	Soils and sediment	VOCs, metals, and radioactive materials	This remedy addresses soils, sediments, surface water, and ground water contamination at the site. The principal threats at this site are contaminated soils containing hazardous substances at the north and south landfills and at the CIBA-GEIGY and the Du Pont Holly Run plants, and contaminated sediments containing hazardous substances in the north drainage way. Treatment is a major component of the remedy at the south landfill while containment is the major component at the other locations due to site-specific conditions.	Radioactive material not relevant to the study.
INEEL	*EPA/ROD/R10-92/036* **Final action**	ID	Sediment	Metals, inorganics, radioactive materials, cesium-37, cobalt-60, and chromium	The selected remedial action for this site included on-site physical separation of large and fine-grained material and implementing institutional controls including deed restrictions.	Very low amounts of radioactive material
Barstow Marine Corps Logistics Base	*EPA/541/R-97/130*	CA	Landfills and trenches	VOCs, radium 228, 226 and gross alpha, and beta levels	Single-layer native soil cap. This alternative includes the installation of a 3-foot native soil cover over the area of CAOC 35 Zone 1. Uncontaminated fill will be imported to CAOC 35 from other parts of the base or off-site.	Very low amounts of radioactive material

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-98/032	CA	Sediment, Soil, and Surface water	Radioactive materials, metals and PCBs	Single-layer native soil cap. This alternative includes the installation of a 3-foot native soil cover over the area of CAOC 35 Zone 1. Uncontaminated fill will be imported to CAOC 35 from other parts of the base or off-site.	Radioactive material was located in animal carcasses
NC State University	*EPA/ROD/R04-96/277*	NC	Soil and groundwater	Low-level radioactive waste, cobalt, and , gamma radiation	This remedy addresses the contamination of soil and groundwater at the site. The soil remedy is in situ mixing and encapsulation. The groundwater remedy consists of extraction and on-site treatment via air stripping, carbon adsorption, and discharge of treated groundwater to surface water or local publicly owned treatment works.	Not enough information to include in the RODs in list
Mound Plant (USDOE)	*EPA/ROD/R05-95/292*	OH	Groundwater, waste materials, and soil	Plutonium -238 and strontium -90	The function of this remedial action is to control groundwater contamination to prevent migration of contamination toward the Mound Plant production wells and to minimize exposure to potential receptors	Very low amounts of radioactive material
Tooele Army Depot (North area)	***EPA/ROD/R08-94/086***	UT	Soils	Radioactive wastes	Filling an area that was excavated during a prior response action; covering the site with 10 inches of clean soil; covering the soil with 2 inches of gravel to reduce the potential exposure to site contaminants.	Waste not landfill or buried.
Rocky Flats Plant (USDOE)	*EPA/ROD/R08-92/065* **Interim remedial action**	CO	Soil and groundwater	Radioactive material and metals	The selected interim remedial action for this site includes constructing an insitu vacuum-enhanced soil vapor extraction system to perform pilot scale remedial tests; filtering extracted vapor using granular activated carbon, with off-site regeneration of spent carbon.	Not landfill waste.

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/541/R-97/196	CO	Soils and sediment	Plutonium, uranium, beryllium, lathe coolants, and radio nuclides	The selected remedy for OU 3 is no action. Based upon the baseline risk assessment and the environmental risk assessment, it has been determined that no action is needed for OU 3. The RFI/RI report concludes that all IHSS's within OU 3 are already in a state protective of human health and the environment. Therefore, no remedial action regarding OU 3 or any of its constituents IHSS's is warranted.	IHSS already in a state protective of human health.
	EPA/541/R-97/195	CO	Soil, subsurface soil, groundwater, surface water/seeps, and sediments	Radionuclides	The action addresses the principal threat posed by OU 1 by excavating subsurface soil contamination at IHSS 119.1, a former drum and scrap metal storage area, thereby removing the current source of groundwater contamination.	Not landfill or buried waste.
Oak Ridge Reservation (USDOE)	*EPA/541/R-98/017* **Interim remedial action**	TN	Soils, sediments, and groundwater	Radioactive	A soil cover, considered an interim measure, will be placed over the concrete pad area with adequate thickness and sufficient areal extent to provide protection from direct exposure to ionizing radiation.	Not landfill waste

Superfund Site	*ROD*	State	Source Type	Contaminants	Remedy	Reason for Elimination
	EPA/ROD/R04-94/183 **Interim remedial action**	TN	Soils	Nitrate, 234U, 235U, and 238U	The abandoned nitric acid pipeline was originally part of the Group 4 Resource Conservation and Recovery Act Facility Investigation Plan developed between 1988 and 1990. On December 21, 1989, ORR was added to the National Priorities List, and the four areas being investigated were separated at EPA's request to be dealt with as individual OUs under the Comprehensive Environmental Response, Compensation, and Liability Act.	Not landfill or buried waste.
	EPA/ROD/R04-93/166 **Final action**	TN	Solids and sludge	Radionuclides U 238, 234, C 137, Tc 99, Am 241, Np 237, Eu 154/155, and Pu 238/230	The selected remedy addresses residual contamination in the K1407-B/C pond soils. The K-1407-B/C ponds are part of the K-1407 OU, which is in theK-25 main plant area. Other designated waste management units within the K- 1407 OU will be evaluated under a separate CERCLA remedial investigation (RI)/feasibility study (FS). In addition, the groundwater contamination in the vicinity of K-1407-B/C ponds will be addressed as part of the sitewide K -25 groundwater OU RI/FS	Not landfill waste.
	EPA/541/R-97/210 **Interim remedial action**	TN	Soils, sediments, and Groundwater	Cesium 137, cobalt 60, plutonium 239, plutonium 238, Americium 24, and strontium 90	The selected remedy address the principal threats to industrial workers and mitigates the release of contamination to groundwater by removal of the sediments from SIOU, and transport of all treated waste to an approved disposal facility and Envirocare of Utah, Inc.	Not landfill waste

Superfund Site	ROD	State	Source Type	Contaminants	Remedy	Reason for Elimination
Oak Ridge Reservation (USDOE)	*EPA/ROD/R05-96/312* **Interim remedial action**	OH	Soil, sediment, and groundwater	Cesium, radium, radon, strontium, technetium, and thorium	Placement of waste in a site disposal facility, and the restoration of the Great Miami Aquifer to its full beneficial use.	Environmental media focused, not landfill or buried waste.
Feed MaterialProduction Center (USDOE)	*EPA/ROD/R05-94/269* **Interim remedial action**	OH	Groundwater, surface water, and soils	Radioactive materials	The selected remedial action for this site includes decontaminating all structures and buildings by removing loose contamination; dismantling the above-grade structures; removing foundations, storage pads, ponds, basins, underground utilities, and other at- and below-grade structures; off-site disposal of waste and debris; off-site recycling of some recyclable material from dismantlement; and storing the remaining waste until the final ROD.	Not landfill or buried waste.
INEEL	*EPA/ROD/R10-92/046* **Remedial action**	ID	Sediment, sludge, and debris	Cesium-137, chromium, metals, volatile organics, semi-volatiles, pesticides, and polychlorinated biphenyls	The INEL site is currently divided into 10 Waste Area Groups (WAGs). This ROD provides an interim remedy for the contaminated sediment and sludge in the evaporation pond, discharge pipe, and waste sump as OU22 in WAG 5. A future ROD will address the underlying aquifer and unsaturated zone. The primary contaminants of concern affecting the sediment, debris, and sludge are metals, including chromium, and radioactive materials.□	Not landfill or buried waste.

Appendix C – Summary of Contaminants of Concern in Downselected RODs

Appendix C. Superfund Sites & Record of Decisions (RODs) Radionuclides Table

Data Source: The N.B. Olewine Co. Inc. 1999 (ROD Info CD)

Superfund Site & ROD	Am - 241	C - 14	Co - 60	Cs - 134	Cs - 137	Eu - 154	Eu - 155	H - 3	K - 40	Np - 237	Pu - 238	Pu - 239 / 240	Ra - 226	Ra - 228	Ra - 233	Ru - 106	Sr - 90	Tc - 99	Th - 228	Th - 229	Th - 230	Th - 232	U - 232	U - 233	U - 234	U - 235	U - 236	U - 238	Superfund Site & ROD
Hanford, 95/126 & 97/044 [1]	✓		✓	✓	✓		✓		✓			✓	✓	✓		✓	✓				✓	✓			✓	✓		✓	**Hanford, 95/126 & 97/044** [1]
Volume																													*Volume*
Concentration	[2]		[2]	[2]	[2]		[2]		[2]			[2]	[2]	[2]		[2]	[2]				972 / 3.5 (pCi/g) [3]	[2]			[2]	51 / 3.9 (pCi/g) [3]		1500 / 104 (pCi/g) [3]	*Concentration*
Hanford 100 Area,EPA/541/R-99/112		✓	✓		✓	✓		✓			✓	✓					✓		✓			✓		✓	✓			✓	**Hanford 100 Area,EPA/541/R-99/112**
Volume																													*Volume*
Concentration																													*Concentration*
Hanford, 96/143			✓		✓								✓						✓						✓			✓	**Hanford, 96/143**
Volume																													*Volume*
Concentration			0.32 (pCi/g)		1.5 (pCi/g)								0.3 - 1 (pCi/g)						0.83 / 2.25 (pCi/g) [4]						59.7 / 2100 (pCi/g) [4]	7.7 / 54.8 (pCi/g) [4]		44 / 2100 (pCi/g) [4]	*Concentration*
Hanford 300 Area, ROD not yet issued			✓	✓	✓						✓	✓					✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	**Hanford 300 Area, ROD not yet issued**
Volume																													*Volume*
Concentration																													*Concentration*
INEEL, 93/070											✓	✓	✓										✓	✓					**INEEL, 93/070**
Volume																													*Volume*
Concentration																													*Concentration*
INEEL, 96/132 & 96/147			✓		✓						✓		✓								✓	✓		✓					**INEEL, 96/132 & 96/147**
Volume																													*Volume*
Concentration																													*Concentration*
Maxey Flats, 91/097		✓	✓		✓			✓			✓	✓	✓				✓					✓		✓	✓	✓		✓	**Maxey Flats, 91/097**
Volume																													*Volume*
Concentration		[2]	0.1 (pCi/g)		0.1 - 0.30 (pCi/g)			10 (pCi/g)	7-22 (pCi/g)		[2]	[2]	0.1 - 0.30 (pCi/g)				[2]					0.70 - 1.50 (pCi/g)		[2]	[2]	[2]		2.0 (pCi/g)	*Concentration*
Melton Valley Watershed, 01-1826&D3	✓		✓		✓			✓				✓					✓												**Melton Valley Watershed, 01-1826&D3**
Volume																													*Volume*
Concentration																													*Concentration*
Moyer Landfill, 85/018					✓									✓			✓	✓											**Moyer Landfill, 85/018**
Volume																													*Volume*
Concentration					0.07-0.11 (pCi/L)									0-1 (Pci/L)			0-3.3 (pCi/L)	20-35 (Pci/L)											*Concentration*
Paducah, 95/235																		✓					✓		✓	✓		✓	**Paducah, 95/235**
Volume																													*Volume*
Concentration																		53 (pCi/g)							10 (pCi/g) [5]	1.0 (pCi/g) [5]		27 (pCi/g) [5]	*Concentration*
FERNALD, 95/286					✓					✓	✓	✓		✓			✓	✓			✓	✓			✓	✓	✓	✓	**FERNALD, 95/286**
Volume																													*Volume*
Concentration					0.01 - 450 (pCi/g)					0.01 - 46 (pCi/g)	0.01 - 4.4 (pCi/g)	0.01 - 15 (pCi/g)		1.25 - 440 (pCi/g)			0.5 - 140 (pCi/g)	0.9 - 3,000 (pCi/g)			1.95 - 12,000 (pCi/g)	1.24 - 840 (pCi/g)			0.94 - 18,000 (pCi/g)	0.13 - 8,800 (pCi/g)	0.13 - 8,800 (pCi/g)	0.92 - 42,000 (pCi/g)	*Concentration*
FERNALD, 95/289 (OU 2)										✓	✓		✓	✓			✓		✓		✓	✓			✓	✓	✓	✓	**FERNALD, 95/289 (OU 2)**
Volume																													*Volume*
Concentration										3.1 (pCi/g)	0.90 (pCi/g)		2.3 (pCi/g)	3.0 (pCi/g)			1.4 (pCi/g)		2.33 (pCi/g)		9.61 (pCi/g)	2.5 (pCi/g)			48.9 (pCi/g)	3.3 (pCi/g)	3.3 (pCi/g)	63.8 (pCi/g)	*Concentration*
Weldon Spring, 93/067										✓	✓		✓	✓			✓	✓	✓		✓	✓			✓	✓	✓	✓	**Weldon Spring, 93/067**
Volume																													*Volume*
Concentration																													*Concentration*
Weldon Spring, 90/043													✓	✓							✓							✓	**Weldon Spring, 90/043**
Volume																													*Volume*
Concentration														0.1-2200 (pCi/g)							0.7-6800 (pCi/g)							1.4-2400 (pCi/g)	*Concentration*

[1] ROD 97/044 was a continuation from ROD 95/126

[2] Information regarding concentration amounts were reported only by type

[3] Concentration levels were found to be higher at the surface (5 ft) and lower at depth (65 ft)

[4] Contaminant levels were reported from both trences and burial grounds

[5] Contaminant was located in the groundwater

Appendix C. Superfund Sites & Record of Decisions (RODs) Organics Table

Data Source: The N.B. Olewine Co. Inc. 1999 (ROD Info CD)

Superfund Site & ROD	1,2-dichloroethene (DCE)	Aroclor 1254	Benzo(a)anthracene	Benzo(e)pyrene	Benzo(e,k)fluoranthene	Dibenzo(a,h)anthracene	DI N Octyl Phthalate	Chloroform	Chrysene	Cyanide	Dichloromethane	Dioxins	Fluoranthene	Methylene Chloride	Indeno(1,2,3-cd)pyrene	Oils	Organic Solvents	Polyaromatic Hydrocarbons (PAHs)	Polychlorinated biphenyls (PCBs)	Phenanthrene	Pyrene	Carbon Tetrachloride	Tetrachloroethene (PCE)	Toluene	Trichloroethene (TCE)	Uranyl Fluoride	Vinyl chloride	VOCs	Superfund Site & ROD
Hanford, 95/126 & 97/044 [1]									✓					✓					✓										**Hanford, 95/126 & 97/044** [1]
Volume																													*Volume*
Concentration									[2]					[2]					[2]										*Concentration*
Hanford 100 Area, EPA/541/R-99/112																												✓	**Hanford 100 Area,EPA/541/R-99/112**
Volume																													*Volume*
Concentration																												[2]	*Concentration*
Hanford, 96/143	✓ [3]				✓				✓										✓				✓		✓ [3]				**Hanford, 96/143**
Volume																													*Volume*
Concentration	0.4 (mg/kg)				27 (mg/kg)				43 (mg/kg)										2.7 (mg/kg)				0.13 (mg/kg)		0.4 (mg/kg)				*Concentration*
Handord 300 Area, ROD not yet issued																													**Handord 300 Area, ROD not yet issued**
Volume																													*Volume*
Concentration																													*Concentration*
INEEL, 93/070				✓														✓	✓										**INEEL, 93/070**
Volume																													*Volume*
Concentration																													*Concentration*
INEEL, 96/132 & 96/147										✓								✓	✓										**INEEL, 96/132 & 96/147**
Volume																													*Volume*
Concentration																													*Concentration*
Maxey Flats, 91/097							✓	✓		✓			✓	✓						✓	✓			✓	✓			✓	**Maxey Flats, 91/097**
Volume																													*Volume*
Concentration							330 (ppm)	5 (ppm)		[2]			330 (ppm)	6 (ppm)						330 (ppm)	330 (ppm)			5 - 250 (ppm)	5 - 250 (ppm)			[2]	*Concentration*
Melton Valley Watershed, 01-1826 & D3																		✓	✓									✓	**Melton Valley Watershed, 01-1826 & D3**
Volume																													*Volume*
Concentration																													*Concentration*
Moyer Landfill, 85/018														✓				✓	✓						✓		✓		**Moyer Landfill, 85/018**
Volume																													*Volume*
Concentration														7-300 (ug/L)											9-20 (ug/L)		0.3-7 (ug/L)		*Concentration*
Paducah, 95/235																✓			✓						✓	✓			**Paducah, 95/235**
Volume																													*Volume*
Concentration																[2]			[2]						[2]	[2]			*Concentration*
FERNALD, 95/286			✓	✓	✓	✓			✓	✓		✓			✓		✓	✓	✓				✓				✓		**FERNALD, 95/286**
Volume																													*Volume*
Concentration			UD - 130,000 (ug/kg)	UD - 110,000 (ug/kg)	UD - 130,000 (ug/kg)	[2]			UD - 100,000 (ug/kg)	[2]		UD - 45.9 (ug/kg)			UD - 46,000 (ug/kg)		[2]	[2]	UD - 13,000 (ug/kg)				UD - 29,000 (ug/kg)				UD - 1,900 (ug/kg)		*Concentration*
FERNALD, 95/289 (OU 2)			✓	✓	✓	✓									✓														**FERNALD, 95/289 (OU 2)**
Volume																													*Volume*
Concentration			890 (ug/kg)	760 (ug/kg)	710 (ug/kg)	200 (ug/kg)									480 (ug/kg)														*Concentration*
Weldon Spring, 93/067																		✓	✓										**Weldon Spring, 93/067**
Volume																													*Volume*
Concentration																													*Concentration*
Weldon Spring, 90/043					✓									✓				✓	✓		✓								**Weldon Spring, 90/043**
Volume																													*Volume*
Concentration					.78-.98 mg/kg									.79-.64					.56-46 mg/kg		.68-170 mg/kg								*Concentration*

[3] Contaminate was located in the groundwater

[4] Undetected

Appendix C. Appendix C: Superfund Sites & Record of Decisions (RODs) Inorganics Table

Data Source: The N.B. Olewine Co. Inc. 1999 (ROD Info CD)

Superfund Site & ROD	Antimony	Arsenic	Benzene	Beryllium	Cadmium	Chromium	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Silver	Thallium	Toluene	Vanadium	Zinc	Superfund Site & ROD
Hanford, 95/126 & 97/044 [1]					✓	✓		✓		✓							✓	**Hanford, 95/126 & 97/044** [1]
Volume																		*Volume*
Concentration					[2]	[2]		[2]		[2]							[2]	*Concentration*
Hanford 100 Area,EPA/541/R-99/112				✓	✓	✓		✓		✓		✓						**Hanford 100 Area,EPA/541/R-99/112**
Volume																		*Volume*
Concentration																		*Concentration*
Hanford, 96/143		✓			✓	✓	✓							✓				**Hanford, 96/143**
Volume																		*Volume*
Concentration		7.6 (mg/kg)			222 (mg/kg)	120 / 20 (mg/kg) [3]	16-83 (mg/kg) [4]							25,000 (mg/km)				*Concentration*
Hanford 300 Area, ROD not yet issued				✓														**Hanford 300 Area, ROD not yet issued**
Volume																		*Volume*
Concentration																		*Concentration*
INEEL, 93/070			✓					✓										**INEEL, 93/070**
Volume																		*Volume*
Concentration																		*Concentration*
INEEL, 96/132 & 96/147								✓						✓				**INEEL, 96/132 & 96/147**
Volume																		*Volume*
Concentration																		*Concentration*
Maxey Flats, 91/097		✓	✓					✓							✓			**Maxey Flats, 91/097**
Volume																		*Volume*
Concentration		[2]	[2]					[2]							[2]			*Concentration*
Melton Valley Watershed, 01-1826 & D3			✓	✓	✓	✓					✓	✓			✓		✓	**Melton Valley Watershed, 01-1826 & D3**
Volume																		*Volume*
Concentration																		*Concentration*
Moyer Landfill, 85/018			✓												✓			**Moyer Landfill, 85/018**
Volume																		*Volume*
Concentration																		*Concentration*
Paducah, 95/235		✓		✓					✓				✓			✓		**Paducah, 95/235**
Volume																		*Volume*
Concentration		[2]		[2]					[2]				[2]			[2]		*Concentration*
FERNALD, 95/286	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		**FERNALD, 95/286**
Volume																		*Volume*
Concentration	6.7 - 320 (mg/kg)	[2]		0.62 - 27 (mg/kg)	0.59 - 39 (mg/kg)	19 - 1,500 (mg/kg)	[2]	[2]	922 - 20,000 (mg/kg)	0.29 - 5.1 (mg/kg)	2.7 - 1,400 (mg/kg)	28.5 - 1,700 (mg/kg)	2.2 - 760 (mg/kg)	0.43 - 110 (mg/kg)		36.9 - 9,700 (mg/kg)		*Concentration*
FERNALD, 95/289 (OU 2)	✓	✓	✓															**FERNALD, 95/289 (OU 2)**
Volume																		*Volume*
Concentration																		*Concentration*
Weldon Spring, 93/067		✓						✓										**Weldon Spring, 93/067**
Volume																		*Volume*
Concentration																		*Concentration*
Weldon Spring, 90/043		✓		✓	✓	✓	✓	✓		✓		✓	✓	✓			✓	**Weldon Spring, 90/043**
Volume																		*Volume*
Concentration		73-120 mg/kg		.45-.83 mg/kg	1.8-98 mg/kg	19-49 mg/kg	38-160 mg/kg	130-410 kg/kg		0.18-6.3 mg/kg		19-120 mg/kg	5.8-8.3 mg/kg	3.0-6.2 mg/kg			68-870 mg/kg	*Concentration*

[1] ROD 97/044 was a continuation from ROD 95/126

[2] Information regarding concentration amounts were reported only by type

[3] Concentration levels were found to be higher at the surface (5 ft) and lower at depth (65 ft)

[4] Values are reported form lowest to highest levels of concentration amounts